PHYSICAL ACTIVITY IN PATIENTS WITH CHRONIC KIDNEY DISEASE

DETERMINANTS OF PHYSICAL ACTIVITY IN CHRONIC KIDNEY DISEASE PATIENTS: AN EXAMINATION OF THE THEORY OF PLANNED BEHAVIOUR

By

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A Thesis

Submitted to the School of Graduate Studies

in Partial Fulfilment of the Requirements

for the Degree

Master of Science

McMaster University

MASTER OF SCIENCE (2006) McMaster University

(Kinesiology) Hamilton, Ontario

TITLE: Determinants of Physical Activity in Chronic Kidney Disease Patients: An Examination of the Theory of Planned Behaviour

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NUMBER OF PAGES: vii, 61

Abstract

Physical activity improves physical and psychological functioning in patients with chronic kidney disease (CKD). However, no studies have investigated the determinants of physical activity in the CKD population. The purpose of the study was to evaluate the utility of the Theory of Planned Behaviour (TPB) for understanding physical activity in the CKD population. A secondary purpose of this study was to examine alternate conceptualizations of the subjective norm construct within the TPB framework. We hypothesized that attitude, subjective norm (injunctive and descriptive norms), perceived behavioural control (PBC), and social support would predict intention to engage in physical activity and that both intention and PBC would predict physical activity behaviour

Participants (52 male, 28 female, mean age = 68.43 (13.21)) were recruited from nephrologists' clinics and were all predialysis (mean serum creatinine = 310.55 (148.75) μmol/L). Participants completed a questionnaire assessing attitude, subjective norm, PBC, and social support. One week later, participants were phoned for a follow-up interview to assess their physical activity during the preceding week.

In a regression model, 61% of the variance in intention to perform physical activity was explained, with PBC (β=.69, p<.001) emerging as the sole significant predictor, while attitude (β=.17, p=.10), subjective norm (β=.02, p=.89), informational support from family (β=-.10, p=.33), and informational support from doctors (β=-.05, p=.54) were non-significant predictors. In a regression model to explain physical activity, 28% of the variance in physical activity was explained, with intention emerging as a significant predictor (β=.53, p=.02), but not PBC (β=.18, p=.29).

The hypotheses were only partially supported, as PBC emerged as a significant predictor of physical activity intention, while attitude, subjective norm, and social support did not. Furthermore, intention, but not PBC, predicted physical activity behaviour. These results demonstrate the utility of the TPB for explaining physical activity in the CKD population. Additional research is required to clarify if targeting PBC may be an effective means for intervention to increase physical activity in the CKD population.

Musings

Education has always been a cornerstone in my life. I've been enrolled in formal education virtually my entire life and though it will continue for only a short time longer, education need not, and in fact, *should* not always be formal. I have learned much from the interactions with my peers and will continue to learn from them as I continue on past formal education. This, of course, is not to slight the classroom experience. I cannot understate the value of a formal education and the conviction with which I believe this is beyond my ability to articulate this belief. An educated society is a society that can flourish, having the knowledge to address the increasingly complex problems of this age.

But at the same time, there is more to education than the classroom. Education is useless without the ability to apply it. Knowledge is a tool, a very powerful tool, but a tool nevertheless. It is in our ability to use knowledge that determines our success as a society, and even as a species. How we use our knowledge, to manipulate, to destroy, to create, is dependent on how we learn to interact with our peers, dependent on the education we receive outside of the classroom. This is something that cannot simply be relayed through a book or in a lecture. We are endowed this wisdom through the experience of living, by being open to learning something everyday, from different people and different cultures, taking something from every experience, no matter how small.

And so, as I bring this chapter of my life to a close ready to begin the next and ready to learn from whatever the world throws at me, I contemplate what I have learned these past two years at McMaster. I have learned many research skills – learned how to analyze and critically assess research, learned how to conduct rigorous research of my own, learned there is no such thing as a perfect study. I have learned much too much to list it all here. Perhaps most importantly though, is that I have learned about myself as well. I have enjoyed the past two years of my life immensely and I will always look back upon these years fondly. And I understand that graduate school is not for everyone, and neither is any form of post-secondary education, but there are many other ways in which people can learn. To this end, I will always encourage people to try something new, to better themselves, and to learn more about the world around them. It is this philosophy by which I attempt to guide my life – to always learn from every experience, to never stop learning...

The day I stop learning is the day that I die.

Acknowledgements

I would not be where I am today without the support of countless individuals. I owe a debt of gratitude to a long list of people: my committee, Steve Bray, Julie Moreland, and Phil Wilson, for all of their insightful comments and helpful input; all the staff at St. Joseph's Healthcare Hamilton for welcoming me as one of their own, and especially Scott Brimble for taking the time to co-ordinate the data collection; all the patients at St. Joseph's who took the time to participate in this study; of course, each and every one of my labmates, past and present, Amy Latimer, Mary Jung, Kelly Arbour, Melissa Galea, Jenn Millen, Matt Kwan, Heather Strong, Anita Garner, Jen Woodgate, and Elizabeth Gunn, for all the advice and more importantly, all the laughs; all my teachers, too many to name, for instilling in me a true appreciation for education and the curiosity to always want to learn more; my friends and family for all that they've given me over the past 26 years, and all that they will continue to give over the next 26 and beyond; and without exception, my supervisor, Kathleen Martin Ginis for being always there, even when she wasn't, guiding me and anticipating all my needs even while on sabbatical in New Zealand, and for being, unequivocally, what a supervisor should be. This thesis is not my thesis – it belongs to all of you.

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The prevalence of chronic kidney failure has more than doubled from 1990 to 2001, and the associated health care costs have nearly tripled in that same time frame (Centers for Disease Control and Prevention, 2004). Chronic kidney disease (CKD) is the slow and progressive deterioration of kidney function. There are varying degrees of severity, beginning with chronic renal insufficiency (CRI), where kidney function is compromised, but does not yet require dialysis treatment or kidney transplantation. Treatments may involve the use of drugs to control blood pressure, therapy for diabetes, epoetin for anaemia, as well as nutritional counselling. As this disease is usually permanent and irreversible, the goal of treatment is often to delay the development of associated co-morbidities, the progression of renal disease, and the onset of end stage renal disease (ESRD; or end stage kidney disease, end stage kidney failure, chronic kidney failure). At this point, the kidneys fail to function at a level that is necessary for normal day-to-day life, typically occurring when kidney function falls below approximately 10% of normal, or baseline. As a result, the body can no longer excrete wastes, concentrate urine, and regulate electrolytes. Without dialysis or kidney transplantation, severe complications and death will likely occur as fluids and waste products accumulate in the body.

The prevalence of patients who have CRI varies, depending on how it is defined. At a glomerular filtration rate (GFR) of less than 30 mL/min, which is approximately equal to serum creatinine levels of greater than 146 and 177 μmol/L for women and men, respectively (Couchoud, Pozet, Labeeuw, & Pouteil-Noble, 1999), the prevalence of CRI among United States adults has been estimated to be between 0.20% (Coresh, Astor, Greene, Eknoyan, & Levey, 2003) and 0.26% (Clase, Garg, & Kiberd, 2002). Similarly, the prevalence of ESRD has also been estimated at 0.2% in the US (Coresh et al., 2003), while the prevalence among other populations include estimates of 0.051% in France (Macron-Nogues et al., 2005), 0.071% to 0.088% in Italy (Vitullo et al., 2003), and 0.79% in India (Agarwal et al., 2005).

Given the severity of the disease, it is not surprising that CKD has profound effects on both an individual's physical and psychological functioning. For individuals who have CKD, simple activities can be a struggle, as fatigue plays a central role in their daily lives (Heiwe, Clyne, & Dahlgren, 2003). Functional capacity is limited, both in terms of endurance as well as strength (Barnea et al., 1980; Gutman, Stead, & Robinson, 1981). Cardiovascular capacity of patients with CRI is approximately 70% to 75% of the expected norm (Clyne, Jogestrand, Lins, & Pehrsson, 1994; Kettner-Melsheimer, Weiss, & Huber, 1987). This value drops further, to approximately 50% to 60% of the expected norm, once the disease progresses to the end stage (Goldberg et al., 1983; Kettner-Melsheimer et al., 1987; Painter, 1994; Sietsema et al., 2002). Although anaemia has been implicated as a contributing factor to this low cardiovascular fitness, erythropoietin therapy to increase hematocrit levels has not been successful at increasing VO_2 to levels that would be expected from a similar treatment of anaemia in individuals without CKD (Painter & Moore, 1994; Robertson et al., 1990).

In addition to reduced physical fitness, individuals with CKD have lowered quality of life (Kouidi, 2004; Kutner, Zhang, & McClellan, 2000), especially on subscales related to physical functioning (Perneger, Leski, Chopard-Stoermann, & Martin, 2003; Tawney et al., 2000). This population also suffers from depression, anxiety, and social problems (Kimmel et al., 2000; Kouidi, 2004). Despite the serious nature of the disease, significant advances have been made to improve the mortality of patients with CKD (Port, Orzol, Held, & Wolfe, 1998). Furthermore, physical activity represents a promising avenue for ameliorating many health problems associated with CKD. Indeed, several investigations have shown that there are physiological as well as psychological benefits associated with regular physical activity.

The Benefits of Physical Activity in the Chronic Kidney Disease Population

The importance of regular physical activity is clearly stated in the 1996 Surgeon General's Report on Physical Activity and Health (U.S. Department of Health and Human Services, 1996). Conclusions of the report included that significant health benefits can be obtained through physical activity and that these benefits apply to people of all ages, both male and female. In addition, the benefits of physical activity extend to reduce the risk of premature mortality in general and mortality due to several disease states in particular, such as cardiovascular disease (CVD), diabetes mellitus, and hypertension – three examples of secondary conditions that are highly prevalent in the CKD population (e.g., CVD – 38.5%, diabetes mellitus – 37.5%, hypertension – 79.9%; Tonelli et al., 2001). Although the CKD population is not specifically addressed by the Surgeon General's Report, evidence is accumulating to support the benefits of physical activity within this population.

Physiological benefits for patients with ESRD. Physical activity has beneficial effects on multiple aspects of physiological function for patients with ESRD. Research has illustrated improvements in muscle strength (DePaul, Moreland, Eager, & Clase, 2002; Heiwe, Clyne, Tollback, & Borg, 2005; Headley et al., 2002), functional capacity (Koufaki, Mercer, & Naish, 2002), and cardiopulmonary functioning (DePaul et al., 2002; Kouidi, Grekas, Deligiannis, & Tourkantonis, 2004; Koufaki et al., 2002; Painter et al., 2002). For example, a 12-week RCT involving both aerobic and resistance training showed improvements in muscle strength, as well as aerobic capacity (DePaul et al., 2002). In this study, the experimental group, when compared to the control group, exhibited greater gains in muscle strength (combined change in quadriceps and hamstring strength: $M = 46.7$ [49.3] lbs compared to $M = 1.4$ [44.7] lbs; $p = .02$) and cardiovascular work capacity ($M = 20$ [18] W compared to $M = 6$ [13] W; $p = .02$). In another RCT, six months of home-based exercise was also shown to be beneficial, where VO_2 max improved 17% ($p < .001$) and exercise time improved 14% ($p < .01$), but was not as effective as a supervised exercise program, where VO_2 max improved 43% ($p < .001$) and exercise time improved 33% ($p < .001$; Deligiannis et al., 1999). In terms of functional capacity, another RCT (Koufaki et al., 2002) has shown that both the time to perform five sit to stand cycles (STS-5) and the number of sit to stand cycles that can be performed in 60s (STS-60) improved significantly after 3 months of bicycling. The time for the STS-5 decreased from $M = 14.7$, $SD = 6.2$ seconds to $M = 11.0$, $SD = 3.3$ seconds ($p < .05$), and the STS-60 increased from $M = 21.2$, $SD = 7.2$ cycles to $M = 26.9$, $SD = 6.2$ cycles ($p < .05$).

Psychological benefits for patients with ESRD. Physical activity also has positive effects on numerous psychological variables, including feelings of depression (Carney et al., 1987; Kouidi et al., 1997), anxiety (Suh, Jung, Kim, Park, & Yang, 2002), self-reported quality of life (Kouidi et al., 1997), perceptions of health (Kouidi et al., 2004), and self-reported functional status (Painter, Carlson, Carey, Paul, & Myll, 2000; Painter et al., 2002). For example, in a 6-month RCT (Carney et al., 1987), aerobic activity reduced depression significantly as measured with the Beck Depression Inventory (BDI). Depressive scores in the experimental group decreased by 4.3, while the control group increased by 2.5 ($p < .05$). Furthermore, before the intervention, 5 of 10 participants in the experimental group, and 3 of 7 in the control, were classified as clinically depressed according to the Diagnostic and Statistical Manual of Mental Disorders III (no difference between groups, $p > .05$), while after the intervention, the rates changed to 1 of 10 and 5 of 7, respectively (groups significantly different, $p < .05$). These results were replicated in another 6-month RCT (Kouidi et al., 1997), where aerobic activity reduced BDI scores from $M = 21.0$, $SD = 10.4$ to $M = 13.7$, $SD = 9.5$ ($p < .05$). And again, this statistical finding was also supported by clinical differences. The number of participants who were classified as severely depressed before the intervention was 7, dropping to 5 afterwards. Similarly, the numbers of moderately and mildly depressed participants were reduced from 5 to 2, and 7 to 3, respectively. This same study also showed improvements in quality of life as assessed with the Quality of Life Index (QLI), with the active participants improving scores from $M = 6.3$, $SD = 1.5$ to $M = 9.0$, $SD = 0.9$ ($p < .05$).

Physiological benefits for patients with CRI. The physical activity literature within the CRI population is more limited, but findings are similar to the literature in the ESRD population. With increased physical activity, improvements have been shown in muscle strength (Boyce et al., 1997; Castaneda et al., 2004; Heiwe, Tollback, & Clyne, 2001) and endurance (Clyne, Ekholm, Jogestrand, Lins, & Pehrsson, 1991), aerobic function (Boyce et al., 1997; Pechter et al., 2003), and functional capacity (Heiwe et al., 2001). For example, in a 12-week resistance training program using healthy elderly subjects as controls, predialysis patients improved their quadriceps one-repetition maximum strength (1-RM) from $M = 8$, $SD = 5$ kg to $M = 13$, $SD = 5$ kg ($p < .0001$; Heiwe et al., 2001). In another study, 3 months of aerobic and strength training increased the static endurance of thigh muscles from a median of 77 s (range 27-197) to 113 s (range 66-201; $p < .002$) and dynamic endurance from a median number of 41 movements (range 28-105) to 93 movements (range 45-139; $p < .001$; Clyne et al., 1991). Additionally, in terms of cardiovascular function, the participants increased their work capacity from $M = 159$, $SD = 49$ W to $M = 174$, $SD = 57$ W ($p < .01$). Boyce and colleagues (1997) also showed that patients' VO_2 peak improved with regular physical activity, increasing by 12% after 4 months of training, then decreasing by 9% after 2 months of detraining ($p < .05$; Boyce et al., 1997). With respect to functional capacity, a more recent investigation (Heiwe et al., 2001) demonstrated that regular physical activity in predialysis patients improved scores on the 6-minute walking test (the distance walked in 6 minutes) and the timed "Up & Go" test (the time a patient rises from an armchair, walks 3 m, turns, walks back, and sits down again). The 6-minute walk score improved from $M = 390$, $SD = 128$ meters to $M = 452$, $SD = 99$ meters ($p = .002$) and the timed "Up & Go" improved from 11 (range 9-46) to 9 s (range 7-27; $p = .004$). Importantly, the magnitude of these improvements was similar to those made by an elderly healthy (i.e., without CKD) comparison group.

Psychological benefits for patients with CRI. The research examining the psychological effects of physical activity in this population is minimal, with only 2 studies found to have examined quality of life. A short intervention revealed no change in quality of life as measured with the Sickness Impact Profile (SIP) after 12 weeks of muscle strength and endurance training (Heiwe et al., 2001). However, the authors suggested that the program, which produced improvements in muscle strength and endurance, may have been too short to effect changes in quality of life. And lending support for this notion is a 6-month investigation where participants were randomized to receive either standard care or a rehabilitation counselling and exercise coaching intervention (participants averaged 4 weekly sessions, participating in a mean of 91.7 min/week of physical activity; Fitts, Guthrie, & Blagg, 1999). There was no difference in the quality of life between the experimental and control groups at baseline, but after the 6-month intervention, the experimental group had significantly better quality of life ($M = 3.3$, $SD = 3.2$; lower is better) compared with controls ($M = 9.8$, $SD = 12.8$; $p < .05$). This difference was maintained for a further 6 months after the intervention was completed, though not at a statistically significant level ($M = 3.9$, $SD = 2.0$ and $M = 9.7$, $SD = 11.0$).

Summary. There have been a number of physical activity research studies involving patients with CKD, including numerous RCTs, and all of which administered an exercise program – that is, structured physical activity. Nearly all of the interventions had participants perform aerobic activity, resistance activity, or both, 3 times each week, with interventions lasting between 12 weeks and 4 years. Some interventions involved home-based exercise, but the majority were based in supervised settings. Much more research has so far focused upon ESRD rather than CRI, but both sets of literature suggest the same thing – that structured physical activity, both resistance and aerobic forms, has beneficial effects on multiple domains of both physiological and psychological functioning, and thus has the potential to improve patients' health.

In terms of the benefits of less structured, leisure time physical activity (such as gardening or going for a walk), less is known. Certainly, it would not be unreasonable to expect that unstructured physical activity would engender similar benefits to health as structured, supervsied exercise programs, and in fact, although conclusions with respect to specific physiological and psychological outcomes cannot be drawn, two studies do suggest a beneficial effect from participation in unsupervised leisure time physical activity. In a one-year prospective study involving over 2,800 patients with CKD, researchers asked the patients how often they did physical activity during their free time. Results showed that sedentary behaviour was associated with an increased risk for death at 1 year (hazard ratio, 1.62; 95% CI, 1.16 to 2.27; O'Hare, Tawney, Bacchetti, & Johansen, 2003). Similarly, mortality risks were lower for patients who participated in leisure time physical activity 2 to 3 (relative risk, 0.74; 95% CI, 0.58 to 0.95) or 4 to 5 times/wk (RR, 0.70; 95% CI, 0.47 to 1.07; Stack, Molony, Rives, Tyson, & Murthy, 2005). Curiously though, no advantage was associated with daily physical activity (RR, 1.06; 95% CI, 0.86 to 1.30). It is important to note that while leisure time physical activity can include both structured forms (such as formal exercise programs) and unstructured forms (such as going for a walk), neither study delineated between these types of physical activity in the physical activity measure and participant responses may have included both.

Although leisure time physical activity appears to be beneficial, neither of the studies assessed the duration or the intensity of leisure time physical activity – only the frequency. This is important, as individuals will require different durations and frequencies of different intensities of physical activity to gain health benefits. For example, the Handbook for Canada's Physical Activity Guide (Health Canada, 1998) recommends that an individual should perform light activity for 60 minutes every day to stay healthy and improve health, while 30 minutes of moderate activity 4 days each week will accomplish the same thing. Much work still needs to be done in order to fully understand the benefits of physical activity in the patients with CKD, but generally, results to date are very encouraging.

Physical Inactivity: Sedentary Lifestyles Among the Chronic Kidney Disease Population

Despite the multitude of benefits that physical activity can provide, the CKD population is extremely inactive. In a study of physical activity using both accelerometers and questionnaire measures of self-reported physical activity, it was shown that individuals with ESRD are less physically active than healthy (i.e., people without CKD) *sedentary* individuals, with activity differences increasing with age (Johansen et al., 2000). Comparing the accelerometry data between the groups, those with ESRD were significantly less active ($M =$

104,718, *SD* = 9,631 arbitrary units per day) compared with the sedentary controls (M = 161,255, *SD* = 6,792; $p < .0001$), while the 7-day Physical Activity Recall questionnaire (PAR) provided similar results, with the estimated energy expenditure significantly less in the ESRD group (M = 33.6, *SD* = 0.5 kcal/kg/day) than in controls (M = 36.2, *SD* = 0.5 kcal/kg/day; $p = .002$). Given that the ESRD patients were compared against sedentary controls, defined as participating in no more than one formal exercise session per week for the previous three months, this finding is particularly alarming.

To date, no study of physical activity levels, including duration and frequency of activity, has been conducted with the CRI population. However, preliminary indications are that this population is also very inactive. In one study, 35.1% of participants stated that they performed physical activity during their free time never, or almost never, with another 21.1% stating that they were active only once a week or less (O'Hare et al., 2003). Although the remaining 44% of participants reported physical activity during their free time at least twice per week, we do not know if these activities are sufficient to provide health benefits since the duration and intensity of physical activity was not assessed. Regardless, given that the majority of individuals with CRI are inactive, there is an urgent need to promote physical activity within this population.

Factors Associated with Physical Activity in Chronic Kidney Disease Patients

There is a dearth of literature on the factors that are associated with physical activity in the CKD population. Some research is available on the issue of adherence to an exercise programme, but none have dealt with the issue of predicting exercise behaviour, or any other types of physical activity behaviour. Adherence rates to an exercise programme for people with CKD vary widely, from as low as 53.3% up to 100% (see Table A1). Common reasons for non-adherence are medical complications, which are often unrelated to the exercise protocol, receipt of a kidney transplant, death, and lack of motivation or disinterest in continuing the programme. So although the majority of the reasons for non-adherence are unmodifiable, there has still been surprisingly little effort made to examine the factors that can be influenced. A few notable exceptions are worth discussion. One study that compared three different exercise programs found that the adherence rate was lower for patients assigned to supervised outpatient exercise on non-dialysis days (76.2%) when compared to both patients assigned to exercise during hemodialysis (83.3%) and those assigned to unsupervised exercise at home (83.3%; Konstantinidou, Koukouvou, Kouidi, Deligiannis & Tourkantonis, 2002). Similarly, a 4-year training program revealed that individuals were more likely to participate in an exercise program if they exercised during dialysis (78.3% completion), as opposed to exercising on non-dialysis days (64.0% completion; Kouidi et al., 2004). Both studies, which had randomly assigned their participants to the differing exercise groups, remarked that transportation difficulties and a lack of time on the non-dialysis days were important factors that contributed to patients dropping out of the studies. Indeed, it has long been known that transportation is an issue with patients on hemodialysis, with 40% citing that they could not participate in a rehabilitation program mainly because of the distance between their residence and rehabilitation centres (Shalom, Blumenthal, Williams, McMurray, & Dennis, 1984).

In the only study that has so far specifically investigated factors that influence exercise adherence in the CKD population, 40 patients were enrolled in a 12-week exercise programme and received weekly interviews with advice and encouragement (Williams, Stephens, McKnight, & Dodd, 1991). Twenty-eight patients exercised at least twice each week and were classified as adherent, while the other 12 were classified as non-adherent. In analyzing the differences between the groups, it was discovered that individuals who adhered were more likely to have encouraging support groups, be younger in age, and have an internal locus of control (Williams et al., 1991). However, this was an observational study (at least in terms of the factors that affect adherence) and we cannot infer that these factors cause patients to adhere to an exercise programme. Accordingly, little direction can be garnered from this study as to how to target interventions for increasing exercise participation, other than the general notion that providing an encouraging support group may help.

It is also important to note that understanding adherence to a structured exercise programme is not the same as understanding why people engage in unstructured forms of physical activity (e.g., going for a walk). They are different, though still closely related issues. Furthermore, given that no research has been performed on predictors of unstructured physical activity within the CKD population, the only clues to solving the problem of inactivity have been garnered from an examination of the issue of adherence to structured exercise programmes. And again, with the majority of research concentrated on the ESRD segment of the population, even less is known with respect to the patients who have CRI. Factors that are associated with structured physical activity, which may also play a role in understanding unstructured physical activity, are time, energy, transportation, and support (Konstantinidou et al., 2002; Williams et al., 1991).

The Need for a Theory

With the deficient state of knowledge concerning the factors associated with physical activity participation, it is not clear how to develop interventions that would increase physical activity participation. Some evidence seems to indicate that, for those patients who are undergoing hemodialysis, exercise during dialysis may be preferable (e.g., Konstantinidou et al., 2002; Kouidi et al., 2004). More generally though, providing accessible facilities (which may include appropriate transportation) and support groups may be part of the solution, but it is unknown whether CKD patients view physical activity positively or negatively, or if they even believe it is possible for them to perform, given their condition.

Little research has explicitly attempted to document factors that are associated with being physically active, so the majority of what is known has been garnered from studies that did not have a primary objective of studying factors associated with physical activity. Furthermore, the knowledge we have gained has been determined without a unifying framework and does not provide an understanding of the underlying processes at work. Only through understanding these processes can researchers and health care practitioners properly develop and implement effective interventions to increase physical activity participation.

One theory that has been frequently used for examining the determinants of physical activity is Ajzen's (1985, 1991) Theory of Planned Behaviour (TPB). The TPB has been shown to be an effective framework for understanding many health-related behaviours (Godin & Kok, 1996) and has been used to examine the determinants of physical activity among many populations with chronic disease or disability, including patients with cardiovascular disease (e.g., Blanchard et al., 2003), patients with cancer (e.g. Courneya, Keats, & Turner, 2000), and patients with spinal cord injury (Latimer, Martin Ginis, & Craven, 2004). However, to date, there have been no studies examining the effectiveness of the TPB for explaining physical activity in the CKD population. Yet, given its proven effectiveness for explaining physical activity in both the general population and other populations with chronic conditions (see meta-analyses, Haggar, Chatzisarantis, & Biddle, 2002; Hausenblaus, Carron, & Mack, 1997), the TPB was considered as an ideal framework in which to couch a study of physical activity determinants in the CKD population.

According to the TPB, an individual's behaviour is determined by his or her intention regarding that behaviour. Intention, in turn, is determined by three constructs: attitude (one's positive or negative evaluation of the behaviour), subjective norm (the perceived social pressure to perform the behaviour), and perceived behavioural control (PBC; the perceived ease or difficulty of performing the behaviour). Moreover, PBC is also considered as a co-determinant of behaviour, along with intention.

Strengths and Weaknesses of the Theory of Planned Behaviour

The ability of the TPB to predict intentions and behaviours for a variety of health-related behaviours has been exemplified by several meta-analyses (e.g. Albarracin, Johnson, Fishbein, & Muellerleile, 2001; Godin & Kok, 1996; Hagger et al., 2002; Hausenblaus et al., 1997). Godin and Kok (1996) analyzed studies of many different health behaviours, which included investigations of physical activity. Across all of the health behaviours, they determined that PBC was the most consistent predictor of intention, being a significant predictor in 85.5% of the studies, followed by attitude then subjective norm, which were significant predictors of intention in 81.6% and 47.4% of the studies, respectively. Overall, these constructs accounted for 40.9% of the variance in intention. Additionally, PBC was a significant predictor of behaviour in 51.2% of the studies. Intention and PBC together accounted for an average of 34.0% of the variance in behaviour. Notably, the subjective norm construct of the TPB has consistently been a poor predictor of intention. Further support for these findings, which are particularly relevant for the current study, can be found in a meta-analysis of 31 studies on exercise behaviour. Results revealed that both attitude and PBC were shown to have much larger effect sizes in their relationships with intention (1.22 and 0.97, respectively) compared to the effect size of the relationship between subjective norm and intention (0.56; Hausenblaus et al., 1997).

Armitage and Conner (2001) have highlighted that the average subjective norm-intention correlation ($r =$. 34) was significantly weaker than both the attitude-intention correlation ($r = .49$, $p < .01$) and the PBC-intention correlation ($r = .43$, $p < .05$), while Godin and Kok (1996) noted that not only did subjective norm reach significance in contributing to explained variance in intention less often than attitude and PBC, but when it did, its weight was lower than the other two constructs. Consequently, some authors have suggested that the problem with subjective norm lies in its measurement (Armitage & Conner, 2001) and its operationalization (Godin & Kok, 1996). For example, with regard to measurement, multiple item measures of subjective norm have been shown to be more strongly related to intention ($r = .38$) than single item measures ($r = .28$, $p <$ .05), suggesting that the weak predictive power of subjective norm within the TPB may be, in part at least, explained by poor measurement of the subjective norm construct (Armitage & Conner, 2001). Thus, by using a multiple item measure of subjective norm, the problem of its weak predictive power may be attenuated somewhat. Beyond this, however, the issue of how social influences are conceptualized in the model may need to be revisited, as has been suggested previously (Courneya, Plotnikoff, Hotz & Birkett, 2000).

A Different Take on Social Influences

Most exercise studies using the TPB as a framework have conceptualized the social influence component of the model as perceived social pressure of what one *ought* to do (i.e., injunctive norms). But as injunctive norm has been a poor predictor of intention, some researchers have begun to consider alternate conceptualizations of social influence. The idea of including descriptive norm (i.e., perceptions of what other people are *actually* doing) into the framework of the TPB has gained much recognition recently. Indeed, in a meta-analysis of 21 studies across a variety of behaviours, Rivis and Sheeran (2003a) showed that descriptive norm increased the variance explained in intention by 5 percent after attitude, injunctive norm, and PBC had been taken into account.

Ajzen (2002) hypothesized that the subjective norm construct does include the more traditional injunctive component and a descriptive component. Ajzen also stated that the addition of the descriptive component is for increasing variability in the measure since the injunctive component may have a limited range due to social desirability, though no published evidence of this could yet be found. Few researchers have thus far investigated this combined conceptualization of subjective norm. Rhodes and Courneya (2003a) did explore the issue in the exercise domain and found some merit in operationalizing subjective norm as a combination of descriptive and injunctive norms. However, they also noted that the combined injunctive and descriptive measure still had a weaker effect ($\beta = .12$) on intention than attitude ($\beta = .25$) and PBC ($\beta = .57$).

Though the descriptive component of subjective norm has garnered a fair bit of attention recently, another type of social influence may play an important role in motivating individuals to participate in physical activity – social support, which is the perception of *assistance* as opposed to *pressure* to perform a behaviour (Rhodes, Jones & Courneya, 2002). Courneya, Plotnikoff, and colleagues (2000) contend that since exercise is not a completely volitional behaviour, subjective norm may not be the most relevant social influence on exercise intention. If a behaviour is not under volitional control, social support should have a greater influence on the performance of the behaviour relative to subjective norm, which should have a greater influence when the behaviour is more volitional. And the data from Courneya, Plotnikoff, and colleagues' study supports this argument, showing that subjective norm was a non-significant predictor of intention ($\beta = .01$), while social support did prove to be a significant predictor ($\beta = .11, p < .001$). The literature in this area is still sparse and further research is required to clarify the issue.

Combining Social Support with Subjective Norms in the Theory of Planned Behaviour

There have been some initial attempts to explore some of the alternate conceptualizations of social influences in the TPB (Okun, Karoly, & Lutz, 2002; Okun et al., 2003; Rhodes & Courneya, 2003a; Rivis & Sheeran, 2003b; Saunders, Motl, Dowda, Dishman, & Pate, 2004) and two studies are particularly relevant to the proposed research. Specifically, Rhodes, Jones and Courneya (2002) investigated the inclusion of both social support and subjective norm in the prediction of exercise intention and determined that social support had a significant effect on exercise intention ($\beta = .23, p < .05$), but subjective norm did not ($\beta = .07, p > .05$). Of note though, descriptive norm was not included in the operationalization of subjective norm and injunctive norm alone was used to assess subjective norm. Thus it may be premature to discard subjective norm in favour of social support, as the choice of the subjective norm measure may not have accurately represented all possible normative influences, having excluded descriptive norm.

In a similar study, Okun and colleagues (2003) included social support and both injunctive *and* descriptive norms in their investigation, revealing that both social support and subjective norm contributed independently to the explained variance in exercise behaviour, but not intention. Bearing in mind that friends, family, and co-workers have all been identified as important social referents of exercise behaviour (Sallis, Grossman, Pinski, Patterson, & Nader, 1987), it is important to consider that Okun and colleagues assessed injunctive norm and descriptive norm relating to only friends. Thus again, the measures may not represent a complete picture of all the social support and normative influences, as all relevant social referents (i.e., friends, family, co-workers; Sallis et al., 1987) should be considered when assessing both subjective norm and social support. Both of these studies investigated physical activity in university/college students and it would be difficult to generalize the results to the CKD population. However, what these studies do show is that there is a basis for the inclusion of both social support and subjective norm when investigating physical activity using the TPB.

Purpose of the Present Study

Given the dearth of research investigating the factors that are associated with physical activity participation in people with CKD, the purpose of this investigation was to evaluate the utility of the TPB for understanding physical activity within the CKD population. The identification of physical activity determinants is an important first step towards developing interventions to increase physical activity participation in this population. A secondary purpose of this study was to examine alternate conceptualizations of the subjective norm construct within the TPB framework. With subjective norm's consistently weak record of predictive ability, social influences were broadened to include both the injunctive and descriptive components of subjective norm, as well as social support.

Hypotheses

In accordance with the tenets of the TPB and based on previous research on alternate conceptualizations of social influences within the TPB, the following hypotheses were formulated:

(1) Attitude, subjective norm, and PBC would be significant, independent predictors of intention to engage in leisure time physical activity behaviour;
(2) social support would also be a significant, independent predictor of intention to engage in leisure time physical activity;
(3) intention and PBC would be significant, independent predictors of leisure time physical activity behaviour;
(4) intention would mediate the relationship between each of the independent predictors of physical activity intention and physical activity behaviour.

Method

Participants

Study participants were patients who have chronic renal insufficiency. In accordance with recommendations of cut-off values for renal impairment (Couchoud et al., 1999), this was defined as patients who have serum creatinine levels of > 177 μmol/L for men and > 146 μmol/L for women. Additional inclusion criteria included mental competence and an understanding of the English language. Eighty participants were recruited for this study. This number was based on power calculations to explain statistically significant variance (medium to large effect sizes) in intention to perform physical activity, as well as physical activity behaviour itself, using the TPB variables in a multiple regression model, while also taking into account participant dropout. All participants were recruited through individual nephrologists' clinics (n = 34) and the Kidney Function Program (KFP; n = 46) at St. Joseph's Healthcare in Hamilton, Ontario. Since participants recruited through KFP were expected to have higher levels of renal impairment compared to participants recruited through individual nephrologists' clinics, stratified sampling was employed (approximately half of the total sample from each source) to ensure that an adequate number of participants, with a relatively high level of renal impairment, was achieved. Participation was strictly voluntary and informed consent was obtained before participation. All KFP patients screened met the creatinine inclusion criterion as reported in their patient charts, however due to language barriers, overall eligibility of KFP patients was approximately 95%. This is in contrast to an eligibility rate of 34% of patients from the clinics. Although the eligibility rate of patients from the clinics was much lower, the consent rate was considerably higher, at 65.4%, compared with only 36.2% for KFP patients (see Table 1).

Table 1
Patient Recruitment from the Kidney Function Program and Individual Nephrologists Clinics

Patient Flow	KFP	Individual Clinic
Screened	135	153
Eligible	127	52
Consented	46	34

Note. KFP = Kidney Function Program.

Measures

As previously stated, the TPB has not yet been used in the physical activity domain within the CKD population. Therefore, TPB measures for the current investigation were drawn from a previous TPB study, which examined physical activity in individuals with spinal cord injury (Latimer & Martin Ginis, 2005). Similar items have been used in populations with cancer (Courneya, Keats, & Turner, 2000) and cardiovascular disease (Blanchard et al., 2003).

Participants were given instructions to respond to the TPB items with respect to performing at least 30 minutes of moderate intensity leisure time physical activity on most days in the next week. For example, one item was "Most people who are important to me think I should participate in moderate intensity leisure time physical activity for at least 30 min on most days in the next week". Drawing from the Handbook for Canada's Physical Activity Guide (Health Canada, 1998), participants were given descriptions of how mild, moderate, and strenuous physical activity feels, as well as examples of activities that would be considered to fall into each intensity category (e.g., brisk walking, swimming, and dancing would be considered moderate physical activities). The complete questionnaire is found in Appendix B.

Attitude. Attitude toward performing at least 30 minutes of moderate intensity leisure time physical activity on most days in the next week was assessed on six differential adjective scales, reflecting both instrumental (valuable-worthless, harmful-beneficial, bad-good) and affective (not enjoyable-enjoyable, unpleasant-pleasant, relaxing-stressful) aspects of attitude. Obtained from Latimer and Martin Ginis (2005; $\alpha = .84$), these items have also been commonly used in other physical activity studies framed with the TPB (e.g. Rhodes & Courneya, 2003a). A statement preceded each 7-point scale: "I think that participating in moderate intensity leisure time physical activity for at least 30 min on most days in the next week would be..." The scale for each of the six items ranged from 1 to 7, with descriptors at 1 and 7 (for example, *1 = extremely valuable, 7 = extremely worthless*). The six items were averaged to obtain a mean attitude score. This scale showed adequate internal consistency ($\alpha = .85$).

Subjective norm. Both the injunctive and descriptive components of the subjective norm construct were assessed. Injunctive norm was assessed with two items using 7-point Likert scales, also drawn from Latimer and Martin Ginis (2005; see also Rhodes & Courneya, 2003a). They were: "Most people who are important to me think I should participate in moderate intensity leisure time physical activity for at least 30 min on most days in the next week" and "Most people who are important to me approve of me participating in moderate intensity leisure time physical activity for at least 30 min on most days in the next week". Each scale had verbal anchors at 1 (*strongly disagree*) and 7 (*strongly agree*). In addition, the descriptive norm component was assessed with the single item: "Most people who are important to me will participate in moderate intensity leisure time physical activity for at least 30 min on most days in the next week".

This item was assessed on a 7-point Likert scale with verbal anchors at 1 (*strongly disagree*) and 7 (*strongly agree*). The two injunctive components and the single descriptive component were averaged to obtain a single subjective norm score. This scale showed adequate internal consistency ($\alpha = .76$).

Perceived behavioural control. Six items scored on 7-point Likert scales were used to assess PBC, three each for the controllability (beliefs about the extent to which performing the behaviour is up to the actor) and self-efficacy (perceived ease or difficulty of performing the behaviour) components of PBC. These items were drawn from Latimer and Martin Ginis (2005; $\alpha = .85$) and similar items have been used in other physical activity studies framed with the TPB (e.g. Rhodes and Courneya, 2003a). Examples of controllability and self-efficacy items were, respectively: "How much do you feel that whether you participate in moderate intensity leisure time physical activity for at least 30 min on most days is beyond your control?" (*1=not at all, 7=very much so*) and "If it were entirely up to me, I am confident that I would be able to participate in moderate intensity leisure time physical activity for at least 30 min on most days in the next week." (*1=strongly disagree, 7=strongly agree*). The complete questionnaire is found in Appendix B. The six items were averaged to obtain a final PBC score. This scale showed adequate internal consistency ($\alpha = .90$).

Intention. The two items obtained from Latimer and Martin Ginis (2005) that were used to assess physical activity intention were: "I will try to do at least 30 minutes of moderate intensity leisure time physical activity on most days in the next week" rated on a 7-point Likert scale ranging from 1 (*definitely true*) to 7 (*definitely false*), and "I intend to do at least 30 minutes of moderate intensity leisure time physical activity on most days in the forthcoming week" rated on a 7-point Likert scale ranging from 1 (*extremely unlikely*) to 7 (*extremely likely*). The two items were averaged to obtain a physical activity intention score. These items have been used in previous research in the physical activity domain in a variety of clinical populations (e.g., Courneya, Friedenreich, Sela, Quinney, & Rhodes, 2002) including individuals with SCI (Latimer & Martin Ginis, 2005; Latimer, Martin Ginis & Craven, 2004).

Physical activity. The Godin Leisure-Time Exercise Questionnaire (GLTEQ; Godin & Shephard, 1985) was used to assess physical activity. The GLTEQ was modified to assess the *past* 7 days as opposed to a *typical* 7 days, and to assess bouts of 30 minutes duration rather 15: "During the past 7-Day period (a week), how many times did you do the following kinds of exercise for more than 30 minutes during your free time?" Patients were asked about participation in strenuous, moderate, and mild exercise. The change from "a typical 7-day period" to "the past 7-day period" was necessary to measure physical activity behaviour during the week between baseline and follow-up, while the change from 15 minute bouts to 30 minute bouts was made to ensure consistency between the behaviour measure and the other TPB measures, which were developed from Health Canada's (1998) recommendations to perform at least 30 minutes of moderate physical activity on at least 4 days of the week.

The GLTEQ, being both brief and easy to use, has been a widely employed measure that possesses good test-retest reliability ($\alpha = .81$; Sallis, Buono, Roby, Micale, & Nelson, 1993). Validity of the measure has also been exhibited, based on various external criteria including subjective criteria, such as the average of 14 4-week physical activity histories, and objective criteria, such as treadmill performance and percent body fat (Jacobs, Ainsworth, Hartman, & Leon, 1993). Finally, the GLTEQ has been used in several physical activity studies framed with the TPB (e.g. Okun et al., 2002; Rhodes & Courneya, 2003a). Although we assessed mild, moderate, and strenuous physical activity, only moderate physical activity was used to test the study hypotheses.

Social support. Chogahara's (1999) multi-dimensional Social Influences on Physical Activity Questionnaire (SIPAQ) was used to assess social support. The SIPAQ consists of 27 items grouped into 6 dimensions: 3 positive (companionship support, informational support, esteem support) and 3 negative (inhibitive behaviour, justifying behaviour, criticizing behaviour). The SIPAQ was developed for older adults and assesses each type of support 3 times, in reference to 3 groups that were identified as important social influences on physical activity: family (all 6 subscales, $\alpha > .70$), friends (all $\alpha > .70$), and health experts or professionals (all $\alpha > .70$, except criticizing subscale $\alpha = .64$; Chogahara, 1999). The items were preceded with the statement "describe how often, during the past 12 months, your friends, your family, and medical experts have done or said the following". Examples of items are: "Informed you about the expected positive effects of a physical activity on your health and fitness" (informational support), and "Told you that more physical activity is not necessary for you because you are already busy in your other daily routines" (justifying behaviour). The complete questionnaire can be found in Appendix B. For the referent of health experts, the companionship support and criticizing behaviour subscales were omitted as they were considered not applicable to the present study. All items were scored from 1 (*never*) to 7 (*very often*). All positive support subscales were adequately internally consistent for family ($\alpha = .91$ to $.94$), friends ($\alpha = .87$ to $.95$), and health experts ($\alpha = .90$ and $.92$). Justifying support from friends ($\alpha = .80$) and inhibitive support from family ($\alpha = .82$) were also adequately consistent, however the remaining negative support subscales were not ($\alpha = .10$ to $.63$).

Demographic and clinical questions. Age, sex, ethnicity, marital status, employment status, and education level data were collected. In addition, the patients were requested to report if they had ever experienced any secondary conditions, such as high blood pressure, heart disease, or diabetes (see Appendix B for the full list).

Procedure

Ethics approval for the study was granted by the St. Joseph's Healthcare Hamilton Research Ethics Board. Participants were recruited from individual nephrologists' clinics and the Kidney Function Program at St. Joseph's Hospital in Hamilton, Ontario. Participating nephrologists asked patients who met the required study inclusion criteria if the study investigator could approach them regarding the study. Once the researcher obtained informed consent from the participant, the participant was asked to complete a questionnaire package, containing demographic and clinical information, as well as questions assessing the participant's attitude, subjective norm, PBC, and intention with respect to moderate intensity leisure time physical activity. In addition to these TPB constructs, the participant was also assessed on social support for physical activity behaviour. The participant and the researcher then scheduled an appointment for a follow-up phone interview one week later. To conclude the baseline interview, the researcher presented the participant with a $5 gift certificate for Tim Horton's. During the follow-up phone interview, consent for participation in the study was reconfirmed and the second questionnaire package was administered. This second questionnaire included the TPB questionnaire and the Godin Leisure Time Exercise Questionnaire. Upon completion of the phone interview, participants were thanked for their time.

Analysis

For descriptive purposes, means and standard deviations for the TPB constructs and social support measures were calculated. Zero order correlations were also computed. Hierarchical linear regression was used to test the study hypotheses. However, before proceeding with the regressions, we tested the assumptions for conducting regression analyses (Tabachnick & Fidell, 2001). Specifically, the data were tested for normality, linearity, and homoscedasticity. After meeting the assumptions of regression, we continued with testing our hypotheses.

Results

Participant Demographics

Participants were recruited from two sites: KFP (n = 46) and individual nephrologists' clinics (n = 34). The mean age of the participants was 68.42 (13.21) years (range = 26 to 91) and 65% were male. As expected, participants recruited from KFP had higher serum creatinine (M = 383.59, SD = 156.88 μmol/L) and lower GFR (M = 15.12, SD = 6.05 mL/min) than participants recruited from individual clinics (M = 211.74, SD = 43.73 μmol/L and M = 26.22, SD = 5.02 mL/min, repectively; $ps < .001$). However, the participants did not differ on other demographic or clinical variables with the exception that more of the participants recruited from individual clinics (22.6%) were more likely to have a history of stroke compared to the participants recruited from KFP (4.7%, p = .02). Between-group differences in serum creatinine, GFR, and age were tested using independent-samples t-tests, while gender, ethnicity, martial status, employment status, annual household income, education, and history of co-morbidities were all tested using Mann-Whitney non-parametric tests. Full demographic characteristics are shown in Table 2.

Table 2
Comparing Demographic and Clinical Variables Across Recruitment Sites

	Recruitment source		
Demographic variable	KFP (n = 46)	Individual clinic (n = 34)	*p*
Creatinine (μmol/L)	383.59 (156.88)	211.74 (43.73)	< .001
GFR (mL/min)	15.12 (6.05)	26.22 (5.02)	< .001
Age	67.24 (14.03)	70.03 (12.02)	.35
Gender			.67
Male	29	23	
Female	17	11	
Ethnicity			.38
Caucasion	43	31	
Other	1	2	
Marital status			.61
Single	1	2	
Married	29	20	
Common law	2	2	
Divorced	3	1	
Separated	1	1	
Widow/er	8	5	
Employment			.72
Full-time	6	1	
Part-time	2	4	
Retired	31	26	
Disability	4	0	
Annual household income			.53
< $20,000	5	5	
$20,000 – 29,999	5	7	
$30,000 – 39,999	9	5	
$40,000 – 49,999	7	3	
$50,000 – 59,999	2	3	
$60,000 – 69,999	0	2	
$70,000 – 79,999	2	1	
$80,000 – 89,999	1	1	
$90,000 – 99,999	0	1	
> $100,000	3	0	

Table 2 (continued)
Comparing Demographic and Clinical Variables Across Recruitment Sites

Demographic variable	Recruitment source: KFP (n = 46)	Recruitment source: Individual clinic (n = 34)	*p*
Education			.44
Did not complete high school	15	13	
Completed high school	10	8	
Some college or university	9	7	
College or university degree	7	1	
Post graduate degree	1	2	
Co-morbidities			
High blood pressure	38	27	.87
Heart attack	8	9	.30
Heart disease	11	10	.53
Diabetes	24	13	.24
Arthritis/rheumatism/joint problem	13	16	.07
Stomach or intestinal problems	6	9	.11
Obesity	8	6	.94
Joint replacement	0	2	.09
Parkinson's disease	0	0	1.00
Lung disease	2	3	.40
Amputation	3	1	.48
Vision loss	10	7	.95
Hearing loss	8	8	.46
Cancer	5	6	.36
Stroke	2	7	.02

Note. KFP = Kidney Function Program; GFR = glomerular filtration rate. Numbers of responses for ethnicity, martial status, employment, income, and education sections do not add up to 46 and 34 for the KFP and individual clinic sites, respectively, due to incomplete questionnaires. Responses for co-morbidities were recorded for 43 of 46 and 31 of 34 participants from the KFP and individual clinic sites, respectively.

Missing Data

Three participants withdrew from the study immediately after enrollment and thus did not provide data for analyses. Among the remaining 77 participants, 1.1% of the data points were missing from the TPB measures, while 15.0% of the data points were missing from the social support measure, due mainly to the fact that 8 participants did not complete any portion of the social support measure. These 8 participants were compared against the remaining participants and no differences were found on any of the TPB, demographic, or clinical variables, with the sole exception that 83.3% (5 of 6 who responded to that question) of those who did not complete the social support measure had a history of heart disease, compared with only 24.5% (16 of 68) of the participants who completed some or all of the social support measure ($p = .02$). Of the 77 participants who responded to baseline measures, 67 completed the follow-up phone interview.

If a participant neglected one or more items from a scale, the missing values were replaced with the mean of the other scale items for that participant. If a participant neglected an entire scale, the mean score for that scale was calculated across all participants and was used to replace the participant's missing scale score. Descriptive statistics are reported for all variables in Table 3.

Table 3
Descriptive Statistics for All Theory of Planned Behaviour and Social Support Variables

Variable	Skewness	Kurtosis	*M*	*SD*
Attitude	-0.77	0.58	4.92	1.34
Subjective norm	-0.95	0.97	5.14	1.47
PBC	-0.49	-0.49	4.28	1.61
Intention	0.03	-1.03	3.82	1.89
PA	0.29	1.98	1.18	2.12
SS (friend)				
Companionship	1.94	2.85	1.69	1.24
Informational	1.34	0.81	2.02	1.39
Esteem	1.41	0.74	2.08	1.62
Inhibitive	3.62	13.68	1.19	0.56
Justifying	4.28	18.98	1.15	0.54
Criticizing	2.83	7.65	1.21	0.54
SS (family)				
Companionship	1.35	0.60	2.16	1.65
Informational	0.69	-0.81	2.97	1.94
Esteem	1.22	0.34	2.38	1.81
Inhibitive	2.90	9.78	1.50	1.10
Justifying	4.68	26.82	1.15	0.44
Criticizing	2.70	6.93	1.28	0.63
SS (doctor)				
Informational	0.37	-1.30	3.15	1.97
Esteem	2.02	3.39	1.93	1.54
Inhibitive	2.82	7.53	1.26	0.66
Justifying	3.82	15.54	1.09	0.31

Note. PBC = perceived behavioural control; PA = moderate physical activity; SS (friend) = social support from friends; SS (family) = social support from family; SS (doctor) = social support from doctors.

Preliminary Analyses: Scale Reliabilities and Differences Between Groups

All of the TPB study measures exhibited adequate internal consistency, including attitude ($\alpha = .85$), subjective norm ($\alpha = .76$), and PBC ($\alpha = .90$). Mean scores for the TPB measures were then compared, using independent-samples t-tests, across the participants who were recruited through KFP and those who were recruited from individual clinics. There were no significant differences between groups on attitude ($p = .16$), subjective norm ($p = .33$), PBC ($p = .14$), intention ($p = .42$), and moderate physical activity ($p = .44$). Additionally, the bivariate correlations between intention and the other TPB variables were not significantly different across the two groups, as presented in Table 4. Thus, the groups were considered equivalent and collapsed for all subsequent analyses.

Table 4
Comparing Bivariate Correlations Among the Theory of Planned Behaviour Variables Between Patient Groups

	Correlation with Intention		
Variable	Patients from KFP	Patients from individual clinics	Difference[a] (*p*)
Attitude	.59***	.67***	.57
Subjective norm	.30*	.35*	.81
PBC	.79***	.77***	.83
PA	.50**	.55**	.85

Note. PBC = perceived behavioural control; PA = moderate physical activity. * $p < .05$. ** $p < .01$. *** $p < .001$.
[a]Difference of the strength of the correlations between the two recruitment sites calculated using Fisher Z transformations.

Examining Social Support

The social support scores were extremely low and 15 of the 16 subscales had mean values of less than 3 on 7-point scales (range 1-7), 10 of which were also less than 2. Additionally, 14 of the subscales had little variability – 41% to 89% of participants responded with a value of 1 on these subscales (see Table A2). When there is little variability in a measure, it is statistically difficult to show covariance with another measure, thus limiting its utility in correlational and regression analyses. Therefore, given this low variability, further analyses were not conducted with these 14 subscales. The only subscales included for further analyses were informational support from family ($M = 2.97$, $SD = 1.93$), and information support from doctors ($M = 3.15$, $SD = 1.97$), both of which exhibited adequate internal consistencies ($\alpha = .91$ and .92, respectively) and were not different between recruitment groups ($p = .38$ and .46, respectively).

Descriptive Statistics

Physical activity levels were very low, with participants engaging in only 1.18 ($SD = 2.12$) bouts of moderate physical activity for at least 30 minutes each week. Mild physical activity was similarly low at 0.85 ($SD = 1.65$) times per week, while strenuous exercise was virtually never performed at 0.03 ($SD = 0.24$) times per week. The descriptive statistics and bivariate correlations among the TPB, social support, and moderate physical activity measures are presented in Table 5. As predicted by the TPB, intention to engage in moderate physical activity was significantly correlated with attitude ($r = .62, p < .01$), subjective norm ($r = .33, p < .01$), PBC ($r = .78, p < .01$). In turn, intention was significantly correlated with moderate physical activity behaviour ($r = .53, p < .01$).

Table 5
Descriptive Statistics and Bivariate Correlations Between the Theory of Planned Behaviour and Social Support Variables

Variable	*M (SD)*	INT	ATT	SN	PBC	PA	SS1
INT	3.82 (1.89)						
ATT	4.92 (1.34)	.62***					
SN	5.14 (1.47)	.33**	.46***				
PBC	4.28 (1.61)	.78***	.69***	.46***			
PA	1.18 (2.12)	.53***	.42***	.20	.49***		
SS1	2.97 (1.93)	.07	.17	.60***	.23*	.06	
SS2	3.15 (1.97)	.09	.22	.36**	.21	.12	.52***

Note. INT = intention; ATT = attitude; SN = subjective norm; PBC = perceived behavioural control; PA = moderate physical activity; SS1 = informational support from family; SS2 = informational support from doctors. * $p < .05$. ** $p < .01$. *** $p < .001$.

Testing Regression Assumptions

Before proceeding with the regression analyses, we tested the regression assumptions according to criteria outlined by Tabachnick and Fidell (2001). We began with an examination of the residuals scatterplots to determine whether the data met the assumptions of normality, linearity, and homoscedasticity. Inspection of the plots revealed that the data met the assumption of linearity, but were also slightly skewed and heteroscedastic. Several transformations of the data were attempted as suggested by Tabachnick and Fidell, but the data remained slightly skewed and heteroscedastic with each transformation. Given that regression is robust with respect to deviations from normality and heteroscedasticity, and data in slight violations of these assumptions still provide a reliable and accurate estimate of regression weights (Kleinbaum, Kupper, Muller, & Nizam, 1998), we took no further steps to correct for either skewness or heteroscedasticity. Analyses were conducted with raw (untransformed) data. Criteria for multicollinearity suggested by Belsley, Kun, & Welsch (1980) are a condition index greater than 30 coupled with at least 2 variance proportions for an individual variable greater than .50. All condition indices were less than 30 (12.73, 15.29, and 9.67) so there was no evidence of high multicollinearity and therefore, the analyses could proceed.

Hypothesis 1: Attitude, Subjective Norm, and PBC Would Predict Intention to Engage in Leisure Time Physical Activity Behaviour

Hierarchical linear regression was used to test whether attitude, subjective norm, and PBC predicted intention to engage in moderate physical activity. Intention was regressed onto attitude and subjective norm (Step 1), then PBC (Step 2). The order of variable entry was based on the tenets of the TPB (Ajzen, 1985). Overall, the model was significant, $F(3,73) = 39.87$, $p < .001$, accounting for 61% of the variance in intention. As shown in Table 6, attitude and subjective norm together accounted for 39% of the variance in intention, $\Delta F(2,74) = 23.69$, $p < .001$, though only attitude was a unique predictor of intention ($\beta = .60$, $p < .001$). Adding PBC in the next step of the model explained an additional 23% of the variance, $\Delta F(1,73) = 44.43$, $p < .001$. However, the beta weight for attitude became non-significant in this step ($\beta = .18$, $p = .08$) and thus, the only unique predictor of intention was PBC ($\beta = .68$, $p < .001$).

Table 6
Hierarchical Linear Regression Models Predicting Intention

Variable	R^2 adj.	ΔR^2	β	t
Model 1				
Attitude	.37	.39***	.60	5.83***
Subjective norm			.06	0.58
Model 2				
Attitude	.37	.39***	.18	1.81
Subjective norm			-.07	-0.80
PBC	.61	.23***	.68	6.67***

Note. PBC = perceived behavioural control. *** $p < .001$

Hypothesis 2: Social Support Would Predict Intention to Engage in Leisure Time Physical Activity

To examine whether social support predicted leisure time physical activity intention, an additional step was added to the previous regression. Therefore, intention was regressed onto attitude and subjective norm (Step 1), PBC (Step 2), then informational support from family and informational support from doctors (Step 3). Overall this model, which is shown in Table 7, was also significant, $F(5,71) = 24.44$, $p < .001$, accounting for 61% of the variance in intention. Again, attitude and subjective norm together accounted for 39% of the variance in intention, $\Delta F(2,74) = 23.69$, $p < .001$, with attitude emerging as the sole unique predictor of intention ($\beta = .60$, $p < .001$). PBC then explained an additional 23% of the variance, $\Delta F(1,73) = 44.43$, $p < .001$. Similar to the regression in hypothesis 1, the beta weight for attitude became non-significant in this step ($\beta =$

.18, p = .08). In the final step of the regression, social support did not explain any additional variance in intention above and beyond the previous two steps, $\Delta F(2,71) = 1.11$, $p = .34$. The only unique predictor of intention in this model was PBC ($\beta = .69$, $p < .001$).

Table 7
Hierarchical Linear Regression Models with Attitude, Subjective Norm, Perceived Behavioural Control, and Social Support Predicting Intention

Variable	R^2 adj.	ΔR^2	β	t
Model 1				
Attitude	.37	.39***	.60	5.83***
Subjective norm			.06	0.58
Model 2				
Attitude	.37	.39***	.18	1.81
Subjective norm			-.07	-0.80
PBC	.61	.23***	.68	6.67***
Model 3				
Attitude	.37	.39***	.17	1.67
Subjective norm			.02	.14
PBC	.61	.23***	.69	6.72***
SS1	.61	.01	-.10	-0.98
SS2			-.05	-0.61

Note. PBC = perceived behavioural control; SS1 = informational support from family; SS2 = informational support from doctors. *** $p < .001$.

Hypothesis 3: Intention and PBC Would Prospectively Predict Leisure Time Physical Activity Behaviour

To examine the determinants of physical activity behaviour, moderate physical activity was regressed on intention (Step 1) and PBC (Step 2). The overall model was significant $F(2,64) = 13.51$, $p < .001$, explaining 28% of the variance in moderate physical activity. Intention accounted for 28% of the variance, $\Delta F(1,65) = 25.82$, $p < .001$ and PBC did not explain any additional variance, $\Delta F(1,64) = 1.14$, $p = .29$. The model is shown in Table 8.

Table 8
Hierarchical Linear Regression Models Predicting Moderate Physical Activity

Variable	R^2 adj.	ΔR^2	β	t
Model 1				
Intention	.27	.28***	.53	5.08***
Model 2				
Intention	.27	.28***	.39	2.29*
PBC	.28	.01	.18	1.07

Note. PBC = perceived behavioural control. * $p < .05$.
*** $p < .001$.

Hypothesis 4: Intention Would Mediate the Relationship Between Each of the Independent Predictors of Physical Activity Intention and Physical Activity Behaviour

Given that neither attitude nor subjective norm were significant, independent predictors of intention in the regression model shown in Table 6, the mediational analyses for these constructs were not conducted. Only PBC was a significant, independent predictor of intention and thus, the mediational analyses were conducted for only PBC. Following the procedure outlined by Frazier, Tix, and Barron (2004), which is illustrated in Figure 1, we tested the mediating role of intention. The analysis examining the determinants of moderate physical activity *intention* tested Path A for PBC, which indicated that PBC was a significant predictor of intention. Similarly, the analysis examining the determinants of moderate physical activity *behaviour* provided support for Path B. We then tested Path C by regressing moderate physical activity onto PBC. This path was significant ($p < .001$), as exhibited in Table 9. Finally, we regressed moderate physical activity onto intention (Step 1; the mediator) before entering PBC into the model (Step 2; the predictor). After controlling for intention, PBC no longer predicted moderate physical activity (p = .29), and thus the conditions for mediation were satisfied. Intention mediated the PBC-behaviour relation.

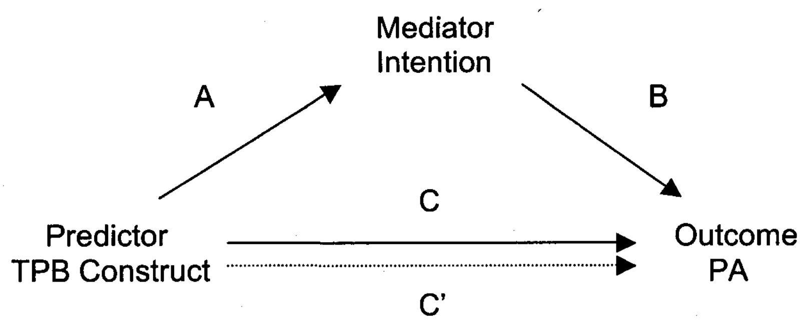

Figure 1. Conceptual model for mediational analyses. The dashed line represents a non-significant relationship after controlling for the mediator (Path B). TPB = Theory of Planned Behaviour; PA = moderate physical activity.

Table 9
Hierarchical Linear Regression Models Predicting Moderate Physical Activity and Examining Intention as a Mediator of the Perceived Behavioural Control-Behaviour Relation

Mediation path tested	*B*	*SE B*	*β*	*t*
Path C				
Outcome: Behaviour				
Predictor: PBC	.64	.14	.49	4.52***
Path C'				
Outcome: Behaviour				
Mediator: Intention	.43	.19	.39	2.29*
Predictor: PBC	.24	.22	.18	1.07

Note. PBC = perceived behavioural control. * $p < .05$. *** $p < .001$.

Summary

The study's four hypotheses are summarized in Table 10. Overall, one hypothesis was supported, two were partially supported, and one was not supported.

Table 10

Summary of Support for Hypotheses

Hypothesis	Support
1. Attitude, subjective norm, and PBC would be significant, independent predictors of intention to engage in leisure time physical activity behaviour	Partial (only PBC predicted)
2. Social support would also be a significant, independent predictor of intention to engage in leisure time physical activity	No
3. Intention and PBC would be significant, independent predictors of leisure time physical activity behaviour	Partial (only intention predicted)
Intention would mediate the relationship between each of the independent predictors of physical activity intention and physical activity behaviour	Yes (intention mediated the PBC-behaviour relation)

Note. PBC = perceived behavioural control.

Discussion

The purpose of this study was to examine the determinants of physical activity in the CKD population. As the first study to utilize the TPB in the CKD population, this study also sought to explore alternate conceptualizations of social influences within the TPB framework. In these respects, our study was moderately successful, with one out of the four hypotheses supported and a further two partially supported. Specifically, PBC, but not attitude and subjective norm, predicted intention to engage in leisure time physical activity behaviour, while social support was also unsuccessful at predicting intention. Intention, in turn, predicted leisure time physical activity behaviour. However, PBC did not directly predict leisure time physical activity behaviour. Rather, the PBC-behaviour relation was completely mediated by intention.

Predicting Intentions: The Utility of the Theory of Planned Behaviour for Explaining Physical Activity in the Chronic Kidney Disease Population

Inconsistent with the tenets of the TPB and our hypothesis, attitude and subjective norm did not predict intention to engage in leisure time physical activity. PBC was the sole significant predictor of intention. Based on Godin and Kok's (1996) meta-analysis of the TPB's application to health behaviours, when all TPB variables have been entered into a regression model, PBC has been a significant predictor of intention in 85.5% of studies, compared with attitude and subjective norm, which were significant in 81.6% and 47.4% of studies, respectively. Thus, with regards to the significance of PBC and subjective norm as predictors of intention, our results are relatively consistent with many previous studies. However, our result with regards to attitude, which was not a significant predictor of intention, runs contrary to the majority of studies.

Subjective norm's lack of predictive power has been given considerable attention and some authors have suggested that the poor ability for explaining intention may be improved with a multiple-item measure of subjective norm (Armitage & Conner, 2001) and the inclusion of a descriptive norm component (Ajzen, 2002; Rivis & Sheeran, 2003a). Although we followed these recommendations when designing the present study, subjective norm was still not a significant predictor of intention. Importantly, research has suggested that different TPB constructs may have more relevance than others in the prediction of intention, depending upon both the target behaviour, as well as the study population (Trafimow & Finlay, 1996). This position is also supported by Ajzen (1991; Aizen[1], 2006), who has stated that a lack of predictive validity for a TPB construct simply indicates that the construct in question is not an important consideration in the formation of intention for the given behaviour and population. Hence, subjective norm may not be a relevant factor in determining

[1] Note that 'Ajzen' has changed his name to 'Aizen'.

physical activity intention in the CKD population. Specifically, there are barriers to physical activity in the CKD population (Shalom et al., 1984; Williams et al., 1991) that may lower an individual's perception of control over performing physical activity. A reduced sense of control, in turn, could hinder an individual's intention to perform physical activity, regardless of any social pressure that the individual may perceive. Thus, it is possible that subjective norm is not a predictive factor for physical activity participation in the CKD population because individuals' perceptions of control are so strong that they may override other influences when forming intentions.

In contrast, attitude has consistently been shown to be a strong predictor of intention (Godin & Kok, 1996; Hagger et al., 2002; Hausenblaus et al., 1997). Therefore, our finding that attitude was not a significant predictor of intention is divergent from the findings of most studies. It is important to note, however, that attitude had a significant bivariate correlation with intention ($r = .62, p < .01$). Moreover, attitude was a significant predictor of intention in the first step of the intention regression; before PBC was entered into the model, attitude and subjective norm explained 39% of the variance in intention and the beta weight associated with attitude was significant. Only after the addition of PBC did attitude no longer predict intention, though the beta weight associated with attitude was still near significance. Given that the bivariate correlation between attitude and PBC was $r = .69$ ($p < .01$), there could be a considerable amount of overlap between these two constructs when accounting for the variance in intention. As a result, this would reduce the amount of unique variance explained by attitude to an insignificant amount. Thus, upon closer examination of the issue, the finding that attitude was not a significant predictor of intention was not as anomalous as it first appeared because the effect that attitude had on intention was overshadowed by the strong effect from PBC.

After having discussed the statistical implication of the high correlation between attitude and PBC, there is an important conceptual issue that also warrants consideration. Within the TPB framework, an individual's attitude, subjective norm, and perception of control are formed from his or her underlying behavioural, normative, and control beliefs, respectively (Ajzen, 1991). These beliefs, in turn, vary as a function of a wide range of background factors, including age, gender, religious affiliation, socioeconomic status, past experience, and personality. Conceptually, the high correlation between attitude and PBC would suggest that these constructs may be tapping into similar beliefs (Ajzen & Fishbein, 2005). That is, attitude and PBC may be based, in part, on the same information. For example, CKD patients who believe that they lack the ability to perform physical activity may anticipate failure or even injury. Consequently this belief could potentially impact both attitude (by leading to the development of a negative attitude towards physical activity) and PBC (by leading to the development of a lack of perceived control). Therefore, the results of this study suggest that a common pool of beliefs may inform both the attitude and PBC constructs.

An important finding in the present study is the amount of variance explained in intention. PBC captured 61% of the variance in intention, while meta-analyses have revealed that studies using the TPB have been able to typically account for only 40.9% (Godin & Kok, 1996) to 44.5% (Hagger et al., 2002) of the variance in intention to perform health behaviours (e.g. physical activity, condom use, smoking, and brushing teeth) and physical activity, respectively. Thus, although attitude and subjective norm failed to predict intention to engage in leisure time physical activity, overall, the TPB does have some utility for explaining physical activity intention in this population.

Social Support for Physical Activity

Contrary to hypothesis, social support did not predict intention to engage in leisure time physical activity. However, it is important to note that the measure that was used to assess social support, the Social Influences on Physical Activity Questionnaire (Chogahara, 1999), produced very little variability in the present study. When there is little variability in a measure, it is statistically difficult to establish covariance with another measure, thus limiting its utility in correlational and regression analyses. So, given their low variability, the majority of the subscales (14/16) were excluded from analyses beyond the descriptive. Having not analyzed such a large number of the social support scales, we cannot make any definitive conclusions on the role of social support for physical activity in the CKD population.

At this point, Chogahara's (1999) social support measure itself warrants discussion. It was developed specifically for use among an elderly population, assessing multiple dimensions of social support for physical activity, as well as multiple sources of support. Thus, it seemed an ideal measure for use in the present study. Yet, any researcher intending its use should be aware of several caveats. First, with 72 items to complete (81 items before we removed two subscales), the measure is extremely lengthy and could pose a significant response burden to a population that is already considerably burdened by disease. This response burden, in turn, could potentially increase the occurrence of response sets (i.e. the tendency to respond in a specific direction regardless of content), which Chogahara (1999) remarked were already a consideration in an elderly sample without any health conditions.

Second, it is worth noting that Chogahara (1999) chose the 12-month time frame for the recall of social support specifically to capture the low frequency of negative support items. Despite this, the frequency of negative support events was still extremely low in our study sample. It is possible that the items used in the Chogahara measure of social support for physical activity are not sensitive to the issues that are relevant to the CKD population. For example, rather than asking how often has someone "told you that you do not need to do more physical activity because you are healthy enough?", it may be more appropriate to ask how often has someone "told you that you do not need to more physical activity because you are too busy with doctors' appointments?" By asking questions that are relevant to the CKD population and that consider their characteristics, the low frequency of endorsing negative support items may be improved.

Third, it should also be known that the low support scores are at least partly attributed to the fact that this population is physically inactive. If the participants are not performing any form of physical activity, the frequency with which they participate in physical activity with other people (companionship support) or receive praise for their physical activity skills (esteem support) is necessarily going to be very low, or nil. This, of course, is not inherently a weakness of this measure, but simply a consequence of one of the population's characteristics.

After careful consideration of the measurement issues, it is possible that the social support measure did not accurately reflect the true social support for physical activity. However, it may also be that social support for physical activity within the CKD population is genuinely very low and that alternative measures of social support would produce similar results. Of course, this would not necessarily dismiss the utility of social support for physical activity in the CKD population, especially since providing support groups to exercising CKD patients has been associated with better adherence to an exercise programme (Williams et al., 1991). What this study may suggest then, is that social support for physical activity in the CKD population is extremely low, while higher levels of social support have an unknown impact.

Predicting Physical Activity: Intention and Perceived Behavioural Control

When predicting leisure time physical activity, intention explained 28% of the variance in physical activity. This is similar to previous findings, with meta-analyses showing that intention typically accounts for between 27.4% (Hagger et al., 2002) and 34.0% (Godin & Kok, 1996) of the variance in physical activity and health behaviours, respectively. However, inconsistent with our hypothesis and the tenets of the TPB, PBC did not explain any additional variance in the performance of leisure time physical activity. On the basis of this result, one might argue that PBC is not an important predictor of physical activity, but it should be noted that PBC did have a significant bivariate correlation with physical activity ($r = .49, p < .01$). To explain why PBC did not emerge as a significant predictor when combined with intention, we also need to examine the bivariate correlation between PBC and intention, which was .78 ($p < .01$). Thus, when regressing physical activity onto both intention and PBC, there could be a significant amount of overlap in the variance explained in physical activity by intention and PBC, consequently reducing the amount of unique variance explained by PBC to an insignificant amount. And in fact, the finding that PBC did not emerge as a significant predictor of behaviour is not uncommon, being non-significant in 49% of studies (Godin & Kok, 1996).

Within the TPB framework, PBC can have both a direct and an indirect (i.e., through intention) effect on behaviour. According to Ajzen and Madden (1986), there are two factors that determine the extent to which PBC directly affects behaviour. The first factor is whether behaviour is under volitional control. For a behaviour that is not under complete volitional control, the performance of the behaviour depends upon non-motivational factors such as the availability of opportunities and resources (Ajzen, 1991). If an individual has control over these opportunities and resources, and intends to perform the behaviour, the individual should succeed in performing the behaviour. On the other hand, if an individual does not have control over the opportunities and resources, the individual should have less success in performing the behaviour, even with high intention to perform the behaviour. Therefore, after controlling for intention, PBC should have a stronger relationship with behaviours that are not under complete volitional control than behaviours that are under complete volitional control. Given this logic and the results of the present study (i.e., PBC did not predict physical activity directly), it might be suggested that physical activity is under volitional control.

To conclude that physical activity is under volitional control, however, may be premature and another perspective warrants consideration. It has been suggested that intention captures the decisional or motivational component of action, but not the implemental component of action (Gollwitzer, 1993). During the motivational phase of performing an action, an individual decides to perform the behaviour. That is, there is some form of cognitive processing that takes place. During the volitional phase (i.e., once an individual decides to perform the behaviour), an individual makes specific plans to ensure that the decision is acted upon (c.f. Ajzen and Madden's opportunities and resources, 1986). Hence, a strong direct relationship between PBC and physical activity would indicate that PBC exerted its effect on the volitional component of engaging in physical activity, whereas a strong indirect route would indicate that PBC exerted its effect on the motivational component of engaging in physical activity. Using this logic, our study findings of no direct effect of PBC on physical activity would suggest that PBC only impacted the motivational phase of performing physical activity and not the volitional phase. This idea is incongruent with the suggestion derived from Ajzen and Madden's aforementioned first factor, that physical activity is volitional.

Given that the CKD population has cited numerous barriers to physical activity, such as transportation, time, and energy (Shalom et al., 1984; Williams et al., 1991), it is highly unlikely that physical activity for these individuals is completely volitional. Rather, it is more likely that physical activity is not under volitional control, and that PBC impacts the motivational phase of physical activity and not the volitional phase as Gollwitzer (1993) suggests. The resolution to this descrepancy, then, may lie with Ajzen and Madden's (1986) second factor related to PBC's impact on behaviour.

According to Ajzen and Madden (1986), the second factor that determines the extent to which PBC directly affects behaviour is how accurate an individual's perceptions of control reflect their actual control. More accurate perceptions of control should result in a stronger relationship between PBC and behaviour after controlling for intention. Given that very little research has assessed the accuracy of people's perceptions of control and how the perceptions of control relate to actual control (Sheeran, Trafimow, & Armitage, 2003), this is a difficult proposition to evaluate. Nevertheless, it has been suggested that people are generally not very accurate at judging how much control they actually have over performing a behaviour (Sheeran et al., 2003). Inaccurate perceptions of control are a very plausible explanation for the results of the present study. Many participants indicated that they perceived little control over performing physical activity, yet, several studies have shown that individuals with CKD, whose renal function has deteriorated far beyond that of the participants in the present study, are very capable of performing regular physical activity over a prolonged period of time (e.g. Konstantinidou et al., 2002; Kouidi et al., 2002; Painter et al., 2000). Therefore there is an alternative explanation for the indirect effect of PBC on physical activity. Rather than suggesting that physical activity for the CKD population is a completely volitional behaviour, the indirect effect may indicate that individuals with CKD have inaccurate perceptions of control with regards to their ability to perform physical activity.

Additionally, the indirect effect of PBC on physical activity is also indicative of another important finding from our study. In partial support of our hypothesis and the tenets of the TPB, intention completely mediated the relation between PBC and physical activity behaviour. Although the TPB suggests that the effects of the TPB constructs on behaviour are mediated by intention, there are few studies that have actually tested for this relationship. Thus, keeping in mind that only one of the three TPB constructs actually predicted intention, our results do lend some support for the mediational role of intention in this theory.

A Word to the Wise: Limitations of the Present Study

As with any study, there are some limitations that are important to discuss. First, the TPB items for this study were drawn from previous TPB studies, none of which involved the CKD population. Ideally, an elicitation study should be performed to determine the salient beliefs underlying each construct that are principal to this specific population (Ajzen, 2002). However, given that these items have been used in many studies, which have shown the utility of the TPB for predicting physical activity in people with chronic disease, and more importantly, given that these items showed the utility of the TPB in the present study, this limitation is probably not of major concern.

Secondly, attitude, subjective norm, and PBC were assessed with direct measures. Consequently, we do not have an understanding of the underlying behavioural, normative, and control beliefs that influence individuals' attitudes, subjective norms, and perceptions of control, respectively. Knowledge of the salient beliefs would aid in the development of the most effective interventions for eliciting changes in the TPB constructs. However, there are factors to consider before using indirect belief-based measures. For example, belief-based measures of attitude, subjective norm, and PBC are not required to be internally consistent (Ajzen, 2002) and thus, the reliability of these measures cannot be assessed in this manner. Ajzen states that, for example, an individual's attitude toward a behaviour can be ambivalent if s/he believes that performing the behaviour is likely to lead to both positive and negative outcomes. The same holds true for the sets of both normative and control beliefs, and as a result, internal consistency is not a necessary feature of belief-based measures. Reliability can, however, still be assessed through temporal stability (i.e., test-retest reliability), which requires measurement at multiple time points. Thus, given that this was not a longitudinal study, assessing temporal stability was not feasible. For the present study, assessing the reliability of the measures was an important issue as these measures had not been previously tested in the CKD population. Hence, the direct measures for attitude, subjective norm, and PBC were chosen.

Third, the amount of variance explained in intention by PBC may be inflated due to measurement redundancy. PBC was assessed with both controllability and self-efficacy components and some research suggests that the self-efficacy construct contains some element of motivation, which is theoretically similar to intention (Rhodes & Courneya, 2003b). Given that Ajzen (2002) conceptualizes PBC to include both controllability and self-efficacy, future studies that wish to include the self-efficacy component may benefit from using items that hold motivation constant by including "If I were really motivated…" or "If I really wanted to…" on each self-efficacy item (Rhodes & Courneya, 2003b). This strategy would reduce the possibility of measurement redundancy and hence, minimize the chance of inflating the amount of variance explained in intention by PBC.

Fourth, although intention was found to mediate the PBC-behaviour relationship, true mediation must satisfy, among other criteria, a temporal criterion (Frazier et al., 2004). That is, mediation implies causation and causation requires the cause to precede the effect. Therefore, future studies testing for mediation would be required to take measurements at three time points such that the predictor variable is assessed first, followed by the potential mediator variable, and then finally the outcome variable. Nevertheless, with this caveat in mind, the mediational results are still an important finding because they support the theory and confirm its utility for understanding physical activity in the CKD population.

Finally, caution should be used when generalizing these results to other patients with CKD. The first point that should be noted is that the generalizability of the findings is limited to the CRI (predialysis) segment of the CKD population. Although patients on dialysis would share many symptoms of the disease, there are also issues unique to the ESRD population that should be considered. For example, hemodialysis patients are already travelling to a dialysis centre three times every week and emerging evidence suggests that this may be a convenient time to deliver an exercise program (Konstantinidou et al., 2002; Kouidi et al., 2004). Thus, the results of this study should only be applied to CKD patients who are not yet on dialysis.

The second matter regarding the generalizability of these results is that there may be some volunteer bias in the present study, as 65% of eligible patients from individual clinics consented to participate, while only 36% of patients from KFP consented. However, given that patients from KFP remarked that they were too tired or had no time to participate in the study (typically, patients from KFP had longer appointments, meeting with more health care providers, and had more impaired renal function compared to patients from individual clinics), inclusion of these individuals would likely not have altered the results. That is, if these individuals were too tired and too busy to complete a short written survey, it would not be unreasonable to expect that they would exhibit poor perceptions of control over physical activity, have low intentions to perform physical activity, and be physically inactive. In essence, the exclusion of these individuals should likely not have an impact on the direction of the relationships. Thus, any volunteer bias that may have occurred is not of major concern.

Where Do We Go From Here: Future Research Recommendations

Despite the aforementioned limitations, the current investigation does present several valuable findings and also raises many further questions for future research. The effect of social support on physical activity is still unknown. With such limited variability on the social support measure and the majority of patients reporting no social support at all on multiple subscales, it is unknown if high levels of social support do affect intentions to perform leisure time physical activity. Additionally, we should also ask why there is so little social support for physical activity in this population. Moderate to high levels of social support for physical activity have been reported in other populations (Courneya et al., 2000; Okun et al., 2003; Rhodes et al., 2002). General social support (i.e., social support not directed specifically at physical activity or anything else) exists for patients with CKD and has been associated with lower mortality (Kimmel et al., 1998). Furthermore, there has been a call to enhance social support in this population (Patel, Peterson, & Kimmel, 2005). What needs to be considered, then, is whether patients' support networks are already very burdened with the disease, and as a corollary, if the support networks have anything left to provide support for physical activity.

The present study was a snapshot of the determinants of physical activity in the CKD population. Although it has provided valuable insight into these determinants of physical activity, a much greater understanding could be garnered from longitudinal research. Specifically, researchers could examine how the TPB constructs change over time and how the TPB constructs may affect not only an individual's physical activity over the next week, but over a prolonged period of time, which ultimately, is of vastly greater importance. Finally, given the strong role that PBC appears to play in influencing physical activity within the CKD population, interventions targeting PBC should be evaluated.

Over many years of investigation with the TPB, researchers have shown that the theory is more effective at explaining intention than actual behaviour itself (Armitage & Conner, 2001; Godin & Kok, 1996; Hagger et al., 2002). Our study followed a similar pattern, explaining 61% of the variance in intention, compared with 28% of the variance in physical activity. The frequency of this pattern of results has prompted efforts to bridge this intention-behaviour gap (e.g., Gollwitzer, 1993) and such pursuits should be encouraged so that physical activity interventions in the CKD population may have a greater impact.

What Can We Do: Practical Implications

The primary implication of this study is that to increase CKD patients' intentions to engage in leisure time physical activity, health care practitioners should target PBC. Strategies for increasing PBC may include giving patients how-to information on performing physical activity and showing patients that other people with CKD are very capable of performing physical activity. On a broader level, appropriate rehabilitation centres should be made easily accessible, both in terms of affordability, as well as location, especially given that transportation is an issue among a large proportion of the CKD population (Shalom et al., 1984). This study also suggests that targeting social pressure (i.e., subjective norm) may not be effective at increasing physical activity intention in this population. Furthermore, although targeting attitude may be effective at increasing intention to engage in physical activity, it would not be as effective as targeting PBC and thus, may not be an appropriate avenue for intervention.

Another finding that has important practical implications is the mediational role that intention played between PBC and physical activity behaviour. Not only does this finding support the theory, but practically, this also provides evidence that an intervention that elicits changes in the TPB constructs would not only improve intention, but also consequently improve behaviour. And given that the TPB constructs accounted for a considerable amount of variance in both intention (61%) and physical activity (28%), there is the potential for an intervention to have a significant impact on physical activity levels of the CKD population, which this study found to be very low.

At the End of the Day: Conclusions

With the purpose of examining the determinants of leisure time physical activity in the CKD population, this study has shown that the TPB framework has some utility for such an endeavour. Although support for the TPB was not overwhelming, the present study was the first to use this theory in the CKD population, explaining 61% and 28% of the variance in intention and physical activity, respectively. The PBC construct emerged as a powerful predictor of intention, which is supported by previous research highlighting numerous barriers to physical activity in the CKD population (Shalom et al., 1984; Williams et al., 1991). Therefore, this study suggests a much needed direction for the development of interventions: by targeting individuals' perceptions of control. And by addressing these perceptions of control, future interventions have the potential to increase physical activity in individuals with CKD, and consequently improve both their physiological and psychological health. The importance of such efforts cannot be understated. As one of our study participants remarked: "Physical activity would be great for me if I could do it. But I just can't…"

References

Agarwal, S. K., Dash, S. C., Irshad, M., Raju, S., Singh, R., & Pandey, R. M. (2005). Prevalence of chronic renal failure in adults in Delhi, India. *Nephrology, Dialysis, Transplantation : Official Publication of the European Dialysis and Transplant Association - European Renal Association, 20*, 1638-1642.

Aizen, I. (2006). *Frequently asked questions*. Retrieved February 22, 2006, from http://www.people.umass.edu/aizen/tpb.html.

Ajzen, I. (1985). From intentions to action: A theory of planned behaviour. In J. Kuhl, & J. Beckmann (Eds.), *Action control: From cognition to behaviour* (pp. 11-39). Heildelberg: Springer-Verlag.

Ajzen, I. (1991). The Theory of Planned Behavior. *Organizational Behavior and Human Decision Processes, 50*, 179-211.

Ajzen, I. (2002). *Construction of a TPB questionnaire: Conceptual and methodological considerations*. Retrieved September 25, 2005, from http://www.people.umass.edu/aizen/tpb.html.

Ajzen, I., & Fishbein, M. (2005). The influence of attitudes on behavior. In D. Albarracín, B.T. Johnson, & M.P. Zanna (Eds.), *The handbook of attitudes* (pp. 173-221). Mahwah, NJ: Erlbaum.

Ajzen, I., & Madden, T. J. (1986). Prediction of goal-directed behavior: Attitudes and perceived behavioral control. *Journal of Experimental Social Psychology, 22*, 453-474.

Albarracin, D., Johnson, B. T., Fishbein, M., & Muellerleile, P. A. (2001). Theories of reasoned action and planned behavior as models of condom use: A meta-analysis. *Psychological Bulletin, 127*, 142-161.

Armitage, C. J., & Conner, M. (2001). Efficacy of the Theory of Planned Behaviour: A meta-analytic review. *The British Journal of Social Psychology / the British Psychological Society, 40*, 471-499.

Barnea, N., Drory, Y., Iaina, A., Lapidot, C., Reisin, E., & Eliahou, H. et al. (1980). Exercise tolerance in patients on chronic hemodialysis. *Israel Journal of Medical Sciences, 16*, 17-21.

Belsley, D. A., Kuh, E., & Welsch, R. E. (1980). *Regression diagnostics: Identifying influential data and sources of collinearity*. New York: John Wiley & Sons.

Blanchard, C. M., Courneya, K. S., Rodgers, W. M., Fraser, S. N., Murray, T. C., & Daub, B. et al. (2003). Is the Theory of Planned Behavior a useful framework for understanding exercise adherence during phase II cardiac rehabilitation? *Journal of Cardiopulmonary Rehabilitation, 23*, 29-39.

Boyce, M. L., Robergs, R. A., Avasthi, P. S., Roldan, C., Foster, A., & Montner, P. et al. (1997). Exercise training by individuals with predialysis renal failure: Cardiorespiratory endurance, hypertension, and renal function. *American Journal of Kidney Diseases : The Official Journal of the National Kidney Foundation, 30*, 180-192.

Carney, R. M., Templeton, B., Hong, B. A., Harter, H. R., Hagberg, J. M., & Schechtman, K. B. et al. (1987). Exercise training reduces depression and increases the performance of pleasant activities in hemodialysis patients. *Nephron, 47*, 194-198.

Castaneda, C., Gordon, P. L., Parker, R. C., Uhlin, K. L., Roubenoff, R., & Levey, A. S. (2004). Resistance training to reduce the malnutrition-inflammation complex syndrome of chronic kidney disease. *American Journal of Kidney Diseases : The Official Journal of the National Kidney Foundation, 43*(4), 607-616.

Centers for Disease Control and Prevention. (2004). State-specific trends in chronic kidney failure – United States, 1990-2001. *Morbidity and Mortality Weekly Report, 53*, 918-920.

Chogahara, M. (1999). A multidimensional scale for assessing positive and negative social influences on physical activity in older adults. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences, 54*, S356-67.

Clase, C. M., Garg, A. X., & Kiberd, B. A. (2002). Prevalence of low glomerular filtration rate in nondiabetic americans: Third national health and nutrition examination survey (NHANES III). *Journal of the American Society of Nephrology : JASN, 13*, 1338-1349.

Clyne, N., Ekholm, J., Jogestrand, T., Lins, L. E., & Pehrsson, S. K. (1991). Effects of exercise training in predialytic uremic patients. *Nephron, 59*, 84-89.

Clyne, N., Jogestrand, T., Lins, L. E., & Pehrsson, S. K. (1994). Progressive decline in renal function induces a gradual decrease in total hemoglobin and exercise capacity. *Nephron, 67*, 322-326.

Coresh, J., Astor, B. C., Greene, T., Eknoyan, G., & Levey, A. S. (2003). Prevalence of chronic kidney disease and decreased kidney function in the adult US population: Third national health and nutrition examination survey. *American Journal of Kidney Diseases : The Official Journal of the National Kidney Foundation, 41*, 1-12.

Couchoud, C., Pozet, N., Labeeuw, M., & Pouteil-Noble, C. (1999). Screening early renal failure: Cut-off values for serum creatinine as an indicator of renal impairment. *Kidney International, 55*, 1878-1884.

Courneya, K. S., Friedenreich, C. M., Sela, R. A., Quinney, H. A., & Rhodes, R. E. (2002). Correlates of adherence and contamination in a randomized controlled trial of exercise in cancer survivors: An application of the Theory of Planned Behavior and the five factor model of personality. *Annals of Behavioral Medicine : A Publication of the Society of Behavioral Medicine, 24*, 257-268.

Courneya, K. S., Keats, M. R., & Turner, R. (2000). Social cognitive determinants of hospital-based exercise in cancer patients following high-dose chemotherapy and bone marrow transplantation. *International Journal of Behavioral Medicine, 7*, 189-203.

Courneya, K. S., Plotnikoff, R. C., Hotz, S. B., & Birkett, N. J. (2000). Social support and the Theory of Planned Behavior in the exercise domain. *American Journal of Health Behavior, 24*, 300-308.

Deligiannis, A., Kouidi, E., Tassoulas, E., Gigis, P., Tourkantonis, A., & Coats, A. (1999). Cardiac effects of exercise rehabilitation in hemodialysis patients. *International Journal of Cardiology, 70*, 253-266.

DePaul, V., Moreland, J., Eager, T., & Clase, C. M. (2002). The effectiveness of aerobic and muscle strength training in patients receiving hemodialysis and EPO: A randomized controlled trial. *American Journal of Kidney Diseases : The Official Journal of the National Kidney Foundation, 40*(6), 1219-1229.

Fitts, S. S., Guthrie, M. R., & Blagg, C. R. (1999). Exercise coaching and rehabilitation counseling improve quality of life for predialysis and dialysis patients. *Nephron, 82*, 115-121.

Frazier, P. A., Tix, A. P., & Barron, K. E. (2004). Testing moderator and mediator effects in counseling psychology. *Journal of Counseling Psychology, 51*, 115-134.

Godin, G., & Kok, G. (1996). The Theory of Planned Behavior: A review of its applications to health-related behaviors. *American Journal of Health Promotion : AJHP, 11*, 87-98.

Godin, G., & Shephard, R. J. (1985). A simple method to assess exercise behavior in the community. *Canadian Journal of Applied Sport Sciences. Journal Canadien Des Sciences Appliquees Au Sport, 10*, 141-146.

Goldberg, A. P., Geltman, E. M., Hagberg, J. M., Gavin, J. R.,3rd, Delmez, J. A., & Carney, R. M. et al. (1983). Therapeutic benefits of exercise training for hemodialysis patients. *Kidney International. Supplement, 16*, S303-9.

Gollwitzer, P. M. (1993). Goal achievement: The role of intentions. *European Review of Social Psychology, 4*, 141-185.

Gutman, R. A., Stead, W. W., & Robinson, R. R. (1981). Physical activity and employment status of patients on maintenance dialysis. *The New England Journal of Medicine, 304*, 309-313.

Hagger, M. S., Chatzisarantis, N. L. D., & Biddle, S. J. H. (2002). A meta-analytic review of the theories of reasoned action and planned behavior in physical activity: Predictive validity and the contribution of additional variables. *Journal of Sport and Exercise Psychology, 24*, 3-32.

Hausenblaus, H. A., Carron, A. V., & Mack, D. E. (1997). Application of the theories of reasoned action and planned behavior to exercise behavior: A meta-analysis. *Journal of Sport and Exercise Psychology, 19*, 36-51.

Headley, S., Germain, M., Mailloux, P., Mulhern, J., Ashworth, B., & Burris, J. et al. (2002). Resistance training improves strength and functional measures in patients with end-stage renal disease. *American Journal of Kidney Diseases : The Official Journal of the National Kidney Foundation, 40*, 355-364.

Health Canada. (1998). *Handbook for Canada's physical activity guide to healthy active living*. Retrieved September 17, 2005, from http://www.phac-aspc.gc.ca/pau-uap/fitness/downloads.html.

Heiwe, S., Clyne, N., & Dahlgren, M. A. (2003). Living with chronic renal failure: Patients' experiences of their physical and functional capacity. *Physiotherapy Research International : The Journal for Researchers and Clinicians in Physical Therapy, 8*, 167-177.

Heiwe, S., Clyne, N., Tollback, A., & Borg, K. (2005). Effects of regular resistance training on muscle histopathology and morphometry in elderly patients with chronic kidney disease. *American Journal of Physical Medicine & Rehabilitation / Association of Academic Physiatrists, 84*, 865-874.

Heiwe, S., Tollback, A., & Clyne, N. (2001). Twelve weeks of exercise training increases muscle function and walking capacity in elderly predialysis patients and healthy subjects. *Nephron, 88*, 48-56.

Jacobs, D. R.,Jr, Ainsworth, B. E., Hartman, T. J., & Leon, A. S. (1993). A simultaneous evaluation of 10 commonly used physical activity questionnaires. *Medicine and Science in Sports and Exercise, 25*, 81-91.

Johansen, K. L., Chertow, G. M., Ng, A. V., Mulligan, K., Carey, S., & Schoenfeld, P. Y. et al. (2000). Physical activity levels in patients on hemodialysis and healthy sedentary controls. *Kidney International, 57*, 2564-2570.

Kettner-Melsheimer, A., Weiss, M., & Huber, W. (1987). Physical work capacity in chronic renal disease. *The International Journal of Artificial Organs, 10*, 23-30.

Kimmel, P. L., Peterson, R. A., Weihs, K. L., Simmens, S. J., Alleyne, S., & Cruz, I. et al. (2000). Multiple measurements of depression predict mortality in a longitudinal study of chronic hemodialysis outpatients. *Kidney International, 57*, 2093-2098.

Kimmel, P. L., Peterson, R. A., Weihs, K. L., Simmens, S. J., Alleyne, S., & Cruz, I. et al. (1998). Psychosocial factors, behavioral compliance and survival in urban hemodialysis patients. *Kidney International, 54*, 245-254.

Kleinbaum, D. G., Kupper, L. L., Muller, K. E., & Nizam, A. (1998). *Applied regression analysis and other multivariate methods* (3rd ed.). Boston: Duxbury Press.

Konstantinidou, E., Koukouvou, G., Kouidi, E., Deligiannis, A., & Tourkantonis, A. (2002). Exercise training in patients with end-stage renal disease on hemodialysis: Comparison of three rehabilitation programs. *Journal of Rehabilitation Medicine, 34*, 40-45.

Koufaki, P., Mercer, T. H., & Naish, P. F. (2002). Effects of exercise training on aerobic and functional capacity of end-stage renal disease patients. *Clin.Physiol.Funct.Imaging, 22*, 115-124.

Kouidi, E. (2004). Health-related quality of life in end-stage renal disease patients: The effects of renal rehabilitation. *Clinical Nephrology, 61 Suppl 1*, S60-71.

Kouidi, E., Grekas, D., Deligiannis, A., & Tourkantonis, A. (2004). Outcomes of long-term exercise training in dialysis patients: Comparison of two training programs. *Clinical Nephrology, 61 Suppl 1*, S31-8.

Kouidi, E., Iacovides, A., Iordanidis, P., Vassiliou, S., Deligiannis, A., & Ierodiakonou, C. et al. (1997). Exercise renal rehabilitation program: Psychosocial effects. *Nephron, 77*, 152-158.

Kutner, N. G., Zhang, R., & McClellan, W. M. (2000). Patient-reported quality of life early in dialysis treatment: Effects associated with usual exercise activity. *Nephrology Nursing Journal : Journal of the American Nephrology Nurses' Association, 27*, 357-67; discussion 368, 424.

Latimer, A. E., & Martin Ginis, K. A. (2005). The Theory of Planned Behavior in prediction of leisure time physical activity among individuals with spinal cord injury. *Rehabilitation Psychology, 50*, 389-396.

Latimer, A. E., Martin Ginis, K. A., & Craven, B. C. (2004). Psychosocial predictors and exercise intentions and behavior among individuals with spinal cord injury. *Adapted Physical Activity Quarterly, 21*, 71-85.

Macron-Nogues, F., Vernay, M., Ekong, E., Thiard, B., Salanave, B., & Fender, P. et al. (2005). The prevalence of ESRD treated with renal dialysis in France in 2003. *American Journal of Kidney Diseases : The Official Journal of the National Kidney Foundation, 46*, 309-315.

O'Hare, A. M., Tawney, K., Bacchetti, P., & Johansen, K. L. (2003). Decreased survival among sedentary patients undergoing dialysis: Results from the dialysis morbidity and mortality study wave 2. *American Journal of Kidney Diseases : The Official Journal of the National Kidney Foundation, 41*, 447-454.

Okun, M. A., Karoly, P., & Lutz, R. (2002). Clarifying the contribution of subjective norm to predicting leisure-time exercise. *American Journal of Health Behavior, 26*, 296-305.

Okun, M. A., Ruehlman, L., Karoly, P., Lutz, R., Fairholme, C., & Schaub, R. (2003). Social support and social norms: Do both contribute to predicting leisure-time exercise? *American Journal of Health Behavior, 27*, 493-507.

Painter, P. (1994). The importance of exercise training in rehabilitation of patients with end-stage renal disease. *American Journal of Kidney Diseases : The Official Journal of the National Kidney Foundation, 24 Suppl 1*, S2-9; discussion S31-2.

Painter, P., Carlson, L., Carey, S., Paul, S. M., & Myll, J. (2000). Low-functioning hemodialysis patients improve with exercise training. *American Journal of Kidney Diseases : The Official Journal of the National Kidney Foundation, 36*, 600-608.

Painter, P., Moore, G., Carlson, L., Paul, S., Myll, J., & Phillips, W. et al. (2002). Effects of exercise training plus normalization of hematocrit on exercise capacity and health-related quality of life. *American Journal of Kidney Diseases : The Official Journal of the National Kidney Foundation, 39*, 257-265.

Painter, P., & Moore, G. E. (1994). The impact of recombinant human erythropoietin on exercise capacity in hemodialysis patients. *Advances in Renal Replacement Therapy, 1*, 55-65.

Patel, S. S., Peterson, R. A., & Kimmel, P. L. (2005). The impact of social support on end-stage renal disease. *Seminars in Dialysis, 18*, 98-102.

Pechter, U., Ots, M., Mesikepp, S., Zilmer, K., Kullissaar, T., & Vihalemm, T. et al. (2003). Beneficial effects of water-based exercise in patients with chronic kidney disease. *International Journal of Rehabilitation Research. Internationale Zeitschrift Fur Rehabilitationsforschung. Revue Internationale De Recherches De Readaptation, 26*, 153-156.

Perneger, T. V., Leski, M., Chopard-Stoermann, C., & Martin, P. Y. (2003). Assessment of health status in chronic hemodialysis patients. *Journal of Nephrology, 16*, 252-259.

Port, F. K., Orzol, S. M., Held, P. J., & Wolfe, R. A. (1998). Trends in treatment and survival for hemodialysis patients in the United States. *American Journal of Kidney Diseases : The Official Journal of the National Kidney Foundation, 32*, S34-8.

Rhodes, R. E., & Courneya, K. S. (2003a). Investigating multiple components of attitude, subjective norm, and perceived control: An examination of the Theory of Planned Behaviour in the exercise domain. *The British Journal of Social Psychology / the British Psychological Society, 42*, 129-146.

Rhodes, R. E., & Courneya, K. S. (2003b). Self-efficacy, controllability and intention in the Theory of Planned Behavior: Measurement redundancy or causal independence? *Psychology and Health, 18*, 79-91.

Rhodes, R. E., Jones, L. W., & Courneya, K. S. (2002). Extending the Theory of Planned Behavior in the exercise domain: A comparison of social support and subjective norm. *Research Quarterly for Exercise and Sport, 73*, 193-199.

Rivis, R., & Sheeran, P. (2003a). Descriptive norms as an additional predictor in the Theory of Planned Behaviour: A meta-analysis. *Current Psychology: Developmental, Learning, Personality, Social, 22*, 218-233.

Rivis, R., & Sheeran, P. (2003b). Social influences and the Theory of Planned Behaviour: Evidence for a direct relationship between prototypes and young people's exercise behaviour. *Psychology and Health, 18*, 567-583.

Robertson, H. T., Haley, N. R., Guthrie, M., Cardenas, D., Eschbach, J. W., & Adamson, J. W. (1990). Recombinant erythropoietin improves exercise capacity in anemic hemodialysis patients. *American Journal of Kidney Diseases : The Official Journal of the National Kidney Foundation, 15*, 325-332.

Sallis, J. F., Buono, M. J., Roby, J. J., Micale, F. G., & Nelson, J. A. (1993). Seven-day recall and other physical activity self-reports in children and adolescents. *Medicine and Science in Sports and Exercise, 25*, 99-108.

Sallis, J. F., Grossman, R. M., Pinski, R. B., Patterson, T. L., & Nader, P. R. (1987). The development of scales to measure social support for diet and exercise behaviors. *Preventive Medicine, 16*, 825-836.

Saunders, R. P., Motl, R. W., Dowda, M., Dishman, R. K., & Pate, R. R. (2004). Comparison of social variables for understanding physical activity in adolescent girls. *American Journal of Health Behavior, 28*, 426-436.

Shalom, R., Blumenthal, J. A., Williams, R. S., McMurray, R. G., & Dennis, V. W. (1984). Feasibility and benefits of exercise training in patients on maintenance dialysis. *Kidney International, 25*, 958-963.

Sheeran, P., Trafimow, D., & Armitage, C. J. (2003). Predicting behaviour from perceived behavioural control: Tests of the accuracy assumption of the Theory of Planned Behaviour. *The British Journal of Social Psychology / the British Psychological Society, 42*, 393-410.

Sietsema, K. E., Hiatt, W. R., Esler, A., Adler, S., Amato, A., & Brass, E. P. (2002). Clinical and demographic predictors of exercise capacity in end-stage renal disease. *American Journal of Kidney Diseases : The Official Journal of the National Kidney Foundation, 39*, 76-85.

Stack, A. G., Molony, D. A., Rives, T., Tyson, J., & Murthy, B. V. (2005). Association of physical activity with mortality in the US dialysis population. *American Journal of Kidney Diseases : The Official Journal of the National Kidney Foundation, 45*, 690-701.

Suh, M. R., Jung, H. H., Kim, S. B., Park, J. S., & Yang, W. S. (2002). Effects of regular exercise on anxiety, depression, and quality of life in maintenance hemodialysis patients. *Renal Failure, 24*, 337-345.

Tabachnick, B. G., & Fidell, L. S. (2001). *Using multivariate statistics* (4th ed.). Boston: Allyn & Bacon.

Tawney, K. W., Tawney, P. J., Hladik, G., Hogan, S. L., Falk, R. J., & Weaver, C. et al. (2000). The life readiness program: A physical rehabilitation program for patients on hemodialysis. *American Journal of Kidney Diseases : The Official Journal of the National Kidney Foundation, 36*, 581-591.

Tonelli, M., Bohm, C., Pandeya, S., Gill, J., Levin, A., & Kiberd, B. A. (2001). Cardiac risk factors and the use of cardioprotective medications in patients with chronic renal insufficiency. *American Journal of Kidney Diseases : The Official Journal of the National Kidney Foundation, 37*, 484-489.

Trafimow, D., & Finlay, K. (1996). The importance of subjective norms for a minority of people: Between-subjects and within-subjects analyses. *Personality and Social Psychology Bulletin, 22*, 820-828.

U.S. Department of Health and Human Services. (1996). *Physical activity and health: A report of the Surgeon General.* Atlanta, GA: U.S. Department of

Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion.

Vitullo, F., Casino, F. G., Di Matteo, A., Di Candia, V. D., Gaudiano, V., & Piras, V. et al. (2003). Epidemiology of end-stage renal disease in an interregional perspective: Registries of Puglia and Basilicata, southern Italy. *Journal of Nephrology, 16*, 813-821.

Williams, A., Stephens, R., McKnight, T., & Dodd, S. (1991). Factors affecting adherence of end-stage renal disease patients to an exercise programme. *British Journal of Sports Medicine, 25*, 90-93.

Appendix A

Supplementary Tables

Table A1

Participant Adherence to Exercise Programmes for Patients with Chronic Kidney Disease

Study	Duration	Exercise Program	Population	No. Execising	Completion Rate	Reasons for Dropout
Boyce et al. (1997)	4 months	Supervised	CRI	15	53.3%	started dialysis physical injury declined participation
Carney et al. (1987)	6 months	Supervised	ESRD	11	90.9%	pressure from employment
Castaneda et al. (2004)	12 weeks	Supervised	CRI	14	100%	
Clyne et al., (1991)	3 months	Supervised	CRI	10	100%	
Deligiannis et al., (1999)	6 months	Supervised during non-dialysis days	ESRD	16	100%	
		Home-based	ESRD	10	100%	
DePaul et al., (2002)	12 weeks	Supervised during dialysis	ESRD	20	75.0%	stopped dialysis medical reasons refused test[a] unable to schedule[a]
Fitts et al., (1999)	6 months	Ex Coaching	CRI and ESRD	25	72.0%	transplant medical reasons declined participation
Headley et al. (2002)	12 weeks	Supervised 2/week, and home exercise 1/week	ESRD	16	62.5%	transplant medical[b] loss of motivation

Table A1 (continued)

Participant Adherence to Exercise Programmes for Patients with Chronic Kidney Disease

Study	Duration	Exercise Program	Population	No. Execising	Completion Rate	Reasons for Dropout
Heiwe et al., (2005)	12 weeks	Supervised	CRI	12	58.3%	started dialysis did not consent to follow-up biopsy[a] non-analysable follow-up biopsy[a]
Heiwe et al., (2001)	12 weeks	Supervised	CRI	23	69.6%	started dialysis cardiac arrhythmia orthopaedic disease
Konstantinidou et al., (2002)	6 months	Supervised outpatient on non-dialysis days	ESRD	21	76.2%	withdrew
		Supervised during dialysis	ESRD	12	83.3%	withdrew death[b]
		Unsupervised at home	ESRD	12	83.3%	withdrew

Table A1 (continued)

Participant Adherence to Exercise Programmes for Patients with Chronic Kidney Disease

Study	Duration	Exercise Program	Population	No. Execising	Completion Rate	Reasons for Dropout
Koufaki et al., (2002)	3 months	Supervised (for those on hemodialysis, exercise was during dialysis)	ESRD	26	69.2%	knee ligament rupture[b] broken ankle[b] death[b] pneumonia loss of interest developed severe arthritis pain non-compliance with exercise prescription frailty
Kouidi et al., (2002)	4 years	Supervised outpatient on non-dialysis days	ESRD	25	64.0%	lack of motivation medical reasons death
		Supervised during dialysis	ESRD	23	78.3%	lack of motivation medical reasons death
Kouidi et al. (1997)	6 months	Supervised druing non-dailysis days	ESRD	24	83.3%	no explanation

Table A1 (continued)

Participant Adherence to Exercise Programmes for Patients with Chronic Kidney Disease

Study	Duration	Exercise Program	Population	No. Execising	Completion Rate	Reasons for Dropout
Painter et al. (2002)	5 months	Supervised during dialysis	ESRD	Unknown[b]		transplant, relocation, or change to CAPD medical reasons out of hematocrit range for testing insufficient training stimulus
Painter et al., (2000)	16 weeks	Home-based (weeks 1-8)	ESRD	286	78.3%	death transplant relocation or change to CAPD disinterest medical complications
		Supervised during dialysis (weeks 9-16)	ESRD			death transplant disinterest medical complications
Pechter et al. (2003)	12 weeks	Supervised	CRI	17	100.0%	

Note. CRI = chronic renal insufficiency; ESRD = end stage renal disease; CAPD = continuous ambulatory peritoneal dialysis.

[a]participant was excluded from follow-up analysis, but may still have adhered to the exercise program – no details were given. [b]Reason for dropout was unrelated to the exercise protocol. [c]Sixty-five participants were randomized to exercising and control groups with no number given for how many were in each group.

Table A2

Social Support Scores: Percent of Participants Scoring 1

Type of social support	Percent
From friends	
Companionship	62
Informational	50
Esteem	52
Inhibitive	84
Justifying	88
Criticizing	82
From family	
Companionship	49
Informational	27
Esteem	41
Inhibitive	73
Justifying	84
Criticizing	75
From medical experts	
Informational	29
Esteem	51
Inhibitive	79
Justifying	89

Appendix B

Complete Questionnaire Package

Determinants of Physical Activity in Kidney Disease Patients:
An Examination of the Theory of Planned Behaviour

Participant # _______

Age: _______

Gender: M / F

Ethnicity: ____________________
(e.g., Caucasian, African American, Asian, etc.)

Marital Status:
- ☐ Single
- ☐ Married
- ☐ Common Law
- ☐ Divorced
- ☐ Separated
- ☐ Widow/er

Employment Status:
- ☐ Full-time
- ☐ Part-time
- ☐ Seeking employment
- ☐ Retired

Annual Household Income:
- ☐ < $20,000
- ☐ $20,000 – $29,999
- ☐ $30,000 – $39,999
- ☐ $40,000 – $49,999
- ☐ $50,000 – $59,999
- ☐ $60,000 – $69,999
- ☐ $70,000 – $79,999
- ☐ $80,000 – $89,999
- ☐ $90,000 – $99,999
- ☐ > $100,000

Education:
- ☐ did not complete high school
- ☐ completed high school
- ☐ some college or university
- ☐ college or university graduate
- ☐ post graduate degree

Have you ever been told you have:
(please check all that apply)
- ☐ high blood pressure
- ☐ heart attack
- ☐ heart disease
- ☐ diabetes
- ☐ arthritis/rheumatism/joint problem
- ☐ stomach or intestinal problems
- ☐ obesity
- ☐ joint replacement
- ☐ Parkinson's disease
- ☐ lung disease
- ☐ amputation
- ☐ vision loss
- ☐ hearing loss
- ☐ cancer
- ☐ stroke

Please read the following instructions carefully.

There are no right or wrong answers. We are simply interested in your opinions regarding doing leisure time physical activity in the next week. Please use the following definition of leisure time physical activity as you respond to these questions:

LEISURE TIME PHYSICAL ACTIVITY includes all of the activities that you choose to do during your free time that require physical exertion.

We are interested in your moderate intensity leisure time physical activity. Please answer the questions with respect to moderate intensity leisure time physical activity.

Examples of leisure time physical activities		How does it feel?	Examples of activities that are NOT leisure time physical activities
Mild	• Light walking • Volleyball • Easy gardening	• Starting to feel warm • Slight increase in breathing rate	• Physiotherapy • Stretching • Shopping • Cleaning • Other activities of daily living
Moderate	• **Brisk walking** • **Biking** • **Raking leaves** • **Dancing** • **Swimming**	• **Warmer** • **Greater increase in breathing rate**	
Strenuous	• Jogging • Hockey • Fast swimming	• Quite warm • More out of breath	

Please answer the questions below using the scales provided. Indicate your response for each question by circling the number that best represents how you feel.

1. How much personal control do you feel you have over whether you participate in moderate intensity leisure time physical activity for at least 30 minutes on most days in the next week?

1	2	3	4	5	6	7
very little control						complete control

2. I think that participating in moderate intensity leisure time physical activity for at least 30 minutes on most days in the next week would be:

1	2	3	4	5	6	7
extremely unenjoyable						extremely enjoyable

1	2	3	4	5	6	7
extremely harmful						extremely beneficial

1	2	3	4	5	6	7
extremely unpleasant						extremely pleasant

3. I will try to do at least 30 minutes of moderate intensity leisure time physical activity on most days in the next week.

1	2	3	4	5	6	7
definitely true						definitely false

4. Most people who are important to me will participate in moderate intensity leisure time physical activity for at least 30 minutes on most days in the next week.

1	2	3	4	5	6	7
strongly disagree						strongly agree

5. If it were entirely up to me, I am confident that I would be able to participate in moderate intensity leisure time physical activity for at least 30 minutes on most days in the next week.

1	2	3	4	5	6	7
strongly disagree						strongly agree

6. Whether or not I participate in moderate intensity leisure time physical activity for at least 30 minutes on most days in the next week is entirely up to me.

1	2	3	4	5	6	7
strongly disagree						strongly agree

7. I think that participating in moderate intensity leisure time physical activity for at least 30 minutes on most days in the next week would be:

1	2	3	4	5	6	7
extremely bad						extremely good

1	2	3	4	5	6	7
extremely relaxing						extremely stressful

1	2	3	4	5	6	7
extremely valuable						extremely worthless

8. How much do you feel that whether you participate in moderate intensity leisure time physical activity for at least 30 minutes on most days in the next week is beyond your control?

1	2	3	4	5	6	7
not at all						very much so

9. Most people who are important to me *think I should* participate in moderate intensity leisure time physical activity for at least 30 minutes on most days in the next week.

1	2	3	4	5	6	7
strongly disagree						strongly agree

10. How confident are you that you will be able to participate in moderate intensity leisure time physical activity for at least 30 minutes on most days in the next week?

1	2	3	4	5	6	7
very unsure						very sure

11. I intend to do at least 30 minutes of moderate intensity leisure time physical activity on most days in the next week.

1	2	3	4	5	6	7
extremely unlikely						extremely likely

12. To what extent do you see yourself as being capable of participating in moderate intensity leisure time physical activity for at least 30 minutes on most days in the next week?

1	2	3	4	5	6	7
very unlikely						very likely

13. Most people who are important to me *approve* of me participating in moderate intensity leisure time physical activity for at least 30 minutes on most days in the next week.

1	2	3	4	5	6	7
strongly disagree						strongly agree

For each of the following questions, use the following scale to describe how often, during the **past 12 months**, your friends, your family, and medical experts have done or said the following. Place a number from 1 to 7 in each of the corresponding boxes to indicate how often people have done the following, with 1 being never and 7 being very often.

1	2	3	4	5	6	7
never						**very often**

Note, medical experts are physicians, nurses, physical therapists, exercise/sport instructors, and other health-related professionals, practitioners, and volunteers.

How often have they…	Friends	Family	Medical Experts
Made plans with you for doing a physical activity together?			N/A
Teamed up with you to engage in a physical activity together?			N/A
Promised you that they would participate in a physical activity with you?			N/A
Given you helpful reminders to do a physical activity together with them?			N/A
Changed their schedules so you could do a physical activity together with them?			N/A
Informed you about the expected positive effects of a physical activity on your health and fitness?			
Explained to you why a physical activity is important to improve your health?			
Clarified for you how you may achieve your health goals through physical activity?			
Suggested a physical activity program or facility which might assist your health?			
Explained to you about the amount or intensity of physical activity necessary for improving your health?			
Complimented you on the mastery of a physical activity skill?			
Praised you that your physical activity level is superior to that of other people your age?			

1 2 3 4 5 6 7
never **very often**

How often have they…	Friends	Family	Medical Experts
Affirmed that you have done well in your physical activity?			
Shown their respect for your versatility in physical activity?			
Told you that you should be proud of your physical activity skills?			
Warned you that starting a physical activity would worsen your health?			
Advised you to avoid a physical activity in order to avoid injury or ill health?			
Told you that you should keep away from a physical activity in order not to have falls or accidents?			
Forbidden you to engage in a physical activity because of the potential health risk?			
Told you that more physical activity is not necessary for you because you are already busy in your other daily routines?			
Told you that you do not need to do more physical activity because you are healthy enough?			
Told you that you do not need to do more physical activity because you know how to care for your health?			
Told you that more physical activity is not necessary for you because you have not had any health problems?			
Excluded you because of your low ability in a physical activity?			N/A
Forced you to do a physical activity which you disliked?			N/A
Complained that your skill in a physical activity is not good enough?			N/A
Criticized your low skill level in a physical activity?			N/A

1. During the past **7-Day period** (a week), how many times did you do the following kinds of exercise for **more than 30 minutes** during your free time.

Times

a) **STRENUOUS EXERCISE**
(HEART BEATS RAPIDLY) __________
(e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)

b) **MODERATE EXERCISE**
(NOT EXHAUSTING) __________
(e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)

c) **MILD EXERCISE**
(MINIMAL EFFORT) __________
(e.g., yoga, archery, fishing from river bank, bowling, horseshoes, golf, snow-mobiling, easy walking)