Physical Activity in End-Stage Renal Disease Patients: A Pilot Project in Puerto Rico

Marta I. Amaral-Figueroa, PhD

Objective: Physical activity has been found to have a positive effect on the clinical outcomes of patients with chronic diseases, including end-stage renal disease (ESRD). The purpose of this study was to describe end-stage renal disease patients on hemodialysis and describe, as well, their physical activity levels.

Methods: Participants were recruited from the renal unit of Hospital Universitario in San Juan. The variables of interest were 1) socio-demographic and health status information and 2) physical activity levels and patterns.

Results: Thirty-one participants with end-stage renal disease completed the questionnaires (17 men and 14 women). The average age of the participants was 54+17 years. Eighty-seven percent (87%) answered that they were not active before beginning hemodialysis treatment. Only 4 patients were employed. These four patients performed activities of moderate intensity ranging from 0 to 2267 MET-mins/week. Nineteen participants reported that they performed a variety of household chores. Home physical activity scores consisted of an average of 1025+1856 MET-mins/week (median 200 MET-mins/week). The total physical activity energy expenditure in leisure-time activities was an average of 111+167 MET-mins/week. The average total physical activity for all the categories from the IPAQ was an average of 1688+2250 MET-mins/week (median 544 MET-mins/week). They sat for about 454+293 minutes per day (approximately 7.5 hours daily). A Spearman's correlation test found there to be a significant inverse relationship between total physical activity energy expenditure and years in hemodialysis treatment, regardless of age (p = -0.301; p<0.05).

Conclusion: In this study, the author describes the physical inactivity in a group of ESRD patients receiving hemodialysis and the significant physical activity variability among them. Moreover, those participants who had been on hemodialysis the longest tended to be the most sedentary, regardless of age. Therefore, it is important to raise awareness, educate and assess, and, if warranted, recommend physical activity to chronic kidney disease patients, including those with end-stage renal disease who are receiving hemodialysis. [*P R Health Sci J 2014;33:74-79*]

Key words: Chronic kidney disease, Hemodialysis, Physical activity/exercise

In the literature, it is well documented that end-stage renal disease (ESRD) patients have poor physical function, which is partially explained by their extremely low physical activity levels (1–5). Physical function is the ability to perform normal activities of daily living (5). It is determined by physical fitness, sensory function, and clinical conditions, but factors related to environmental and behavioral issues also play an important role. Additionally, the following physiological factors are linked to poor physical function in end-stage renal disease patients: 1) functional and structural muscle abnormalities, 2) inflammation, 3) blood flow, and 4) anemia (1). Moreover, physical inactivity is considered a negative prognostic factor for survival in hemodialysis. Dialysis patients with low levels of physical activity have a 62% greater risk of mortality (1, 6). Therefore, the physical activity levels of ESRD patients should be assessed and, if warranted, increased physical activity prescribed as adjunct therapy.

Bennett and colleagues (7) found 171 peer-reviewed published articles that focused on exercise in dialysis patients. In the article resulting from their investigation, Bennett and colleagues discussed the benefits of exercise for individuals with ESRD, advocated the inclusion of exercise programs as standards of care and practice, and proposed an argument for the sustainability of such programs in a clinical setting. They discussed the factors contributing to sustainable exercise programs for ESRD patients in a dialysis facility, placing special emphasis on the evidence-based benefits of such programs in terms of the health and clinical outcomes of the patients.

Department of Physical Education and Recreation, University of Puerto Rico Rio Piedras Campus, Puerto Rico

The author has no conflicts of interest to disclose.

Address correspondence to: Marta I. Amaral-Figueroa, PhD, University of Puerto Rico Rio Piedras Campus, Department of Physical Education and Recreation, PO Box 23311, San Juan, PR 00931-3311. Email: marta.amaral1@upr.edu

However, the topic of exercise-program sustainability is beyond the scope of this article and will not be further discussed. The evidence as put forth by Bennett and his team shows that ESRD dialysis patients who took part in dialysis exercise programs reaped specific benefits. After their participation, these patients saw improvements in such areas as cardiovascular risk factors, quality of life, physical function, and dialysis efficacy; other benefits included decreases in the levels of markers for inflammation, depression, and mortality. In another review and meta-analysis investigation, Heiwe and Jacobson (8) focused on 45 studies (1863 patients) (of which 45 studies, 32 presented data that could be meta-analyzed) that were randomized control trials in which ESRD patients participated in an exercise program for at least 8 weeks or more. The purpose was to assess the effects of exercise on this population and determine how these programs should be designed. Heiwe and Jacobson concluded that there is significant evidence showing that regular exercise benefits ESRD patients in terms of physical fitness, walking capacity, cardiovascular dynamics, quality of life, and a variety of nutritional parameters. Finally, Smart and Steele (9) reported on their meta-analysis of the published data regarding the effects of exercise training in hemodialysis patients. They were interested in changes in VO2 peak (defined as the highest oxygen consumption point attained in a standardized exercise test) scores, quality of life, cardiac function, strength, and energy intake. After using strict inclusion criteria, they used the data from 15 studies (565 patients) for their analysis. They concluded that exercise training is safe and that it significantly improves VO2 peak and sympatho-adrenal activity in hemodialysis patients. They concluded, as well, that dialysis patients who engage in exercise programs during their treatment regimens are more likely to adhere to those programs than they are when said programs are not part of their regimens.

A number of clinical research studies have also evidenced the fact that exercise programs for dialysis patients not only are safe but also are effective in improving cardiovascular function (e.g., lower blood pressure, lower heart rate), endocrine function (better glycemic control), physical functioning, muscle morphology and metabolism, dialysis efficacy, and quality of life (10–19).

Therefore, the National Kidney Foundation has specific recommendations for assessing and counseling physical activity for ESRD patients, including those at high risk for cardiac events (20). This is relevant given the fact that approximately, 25%–50% of dialysis patients are at a high risk of a negative cardiac event (1, 9). However, there have been no reports in the literature of any negative cardiac events during exercise/physical activity studies. Nonetheless, there are a few trials that have reported some clinical symptoms after an exercise bout, which include hypotension, leg cramping, nausea, vomiting, and headaches (1, 14). Thus, suggesting that the adequate supervision and evaluation of the symptoms that might occur in any one of these patients before, during, and/or after an exercise bout must be part of the program (21-23).

The consensus appears to be that physical activity is a rehabilitative tool that should be included in the standard of care for end-stage renal disease patients receiving hemodialysis (2, 6-7, 9, 12-13, 24-26). However, physical activity levels remain low in this group of patients. In Puerto Rico, the prevalence of end-stage renal disease (ESRD) is 990 cases per year, with an incidence of about 332 cases, but the physical activity characteristics of these patients are unknown (27). Since physical activity is an important behavior not only as prevention tool but also in the management of chronic diseases, it is important and pertinent to begin assessing and recommending such activity to chronic kidney disease patients, including those receiving hemodialysis. In ESRD patients, reduced physical activity often leads to reduced physical function, which is a negative prognostic indicator of survival. The occurrence of this chain of events warrants the assessment and—when called for—subsequent prescription of physical activity as a component of ESRD patient treatment. Therefore, the purpose of this study was to describe both end-stage renal disease patients on hemodialysis and their physical activity levels.

Methods

Participants

The prospective study members were recruited from the renal unit of Hospital Universitario, which is located in the San Juan, PR, metropolitan area. The participants received and signed an informed consent before taking part in the study (University of Puerto Rico, Rio Piedras, Institutional Review Board, #0809-144). To participate in the study, the prospective candidate had to be a consenting adult with end-stage renal disease and had to be receiving hemodialysis. The investigator offered a lecture about physical activity, renal disease, and the purpose of the study to the prospective candidates while they were waiting to receive treatment in the dialysis unit. Afterwards, those patients who were interested contacted the investigator. Then, an appointment was made to complete the interview and the questionnaires before receiving treatment in the unit.

Variables and instruments

There were 2 variables of interest: 1) socio-demographic/health status characteristics, and 2) physical activity behavior characteristics.

A structured interview was performed to obtain the following socio-demographic and health information: gender, age, educational level, marital status, income, health-insurance and employment status, medical history, co-morbidities, past and/or current treatments, and previous physical activity. The Spanish version of the International Physical Activity Questionnaire

(IPAQ) was also administered. This questionnaire divides physical activity into 5 categories: 1) job-related physical activity, 2) transportation physical activity, 3) housework, house maintenance, and caring for family, 4) recreation, sport, and leisure-time physical activity, and 5) time spent sitting. This Spanish version has been found to have a good reliability coefficient for total physical activity ($r = 0.82$; $P<0.05$), vigorous activity ($r = 0.79$; $P<0.05$), moderate activity ($r = 0.83$; $P<0.05$), and time spent sitting ($r = 0.73$; $P<0.05$). Also, total time spent on work-related activities ($r = 0.92$; $P<0.05$), on household-related activities ($r = 0.86$; $P<0.05$), and on leisure-time physical activities (excluding walking) ($r = 0.82$; $P<0.05$) showed good reliability coefficients (28, 29).

Statistical analysis

This is a descriptive pilot study. Therefore, standard deviations, and median and interquartile ranges are presented for all continuous variables. Furthermore, the data for the categorical variables are presented in frequencies and percentages. The SPSS 20.0 for Windows statistical package was used for the management and analysis of the data (IBM SPSS Statistics program).

Results

Socio-demographic/Health characteristics

The socio-demographic and health characteristics of the study participants are presented in Table 1. There were 17 men and 14 women (n = 31), with an average age of 54+17 years. Fifty-four percent of the participants were married, 62% had an education level below high school, and the annual incomes of 81% of the participants were less than $10,000.00. The most common co-morbidities in this group of participants were hypertension (71%), anemia (64%), and diabetes (51%). Their dialysis treatment regimen consisted of 3 treatments per week, mostly from 4 to 4.5 hours per treatment. There was a great deal of variability in the amount of time since the beginning of hemodialysis treatment, which was, on average, 8 years (minimum, 4 years; maximum, 27 years).

Physical activity

Participants were asked if they were physically active before they were diagnosed with end-stage renal disease. To be considered physically active, the participant had to have engaged in at least 150 minutes per week of moderate to vigorous activity (30). Eighty-seven percent answered that they had not been active before beginning hemodialysis treatment. To assess the current level of physical activity, we used the Spanish version of the IPAQ (long format, self-administered). In the process of cleaning and scoring the data obtained using the IPAQ, the author followed the "Guidelines for data processing and analysis of the International Physical Activity Questionnaire" by the IPAQ Research Committee (31). It should be noted that most of the participants answered only those questions regarding physical activity related to transportation and time spent sitting and not those in the other categories that the IPAQ evaluates. In the end, the data from 26 of the 31 participants were used for the analysis. Table 2 describes the scoring results for the categories of the IPAQ. It contains the averages, and standard deviations, minimums, and maximums, medians, and interquartile ranges for the categories.

Table 1. Socio-demographic/health characteristics of the participants (n = 31)

Variable	Result
Gender	17 males (54.8 %) 14 females (45.2 %)
Age (years)	54+17*
Education	Less than a high school diploma (n = 19, 62%)
Income	Less than $10,000/year (n = 25, 81%) $10,000–$49,999 (n = 5, 16%) $50,000 or more (n = 1, 3%)
Currently working	Yes (n = 4, 13%) No (n = 27, 87%)
Co-morbidities	Hipertension (n = 22, 71%) Anemia (n = 20, 64%) Diabetes (n = 16, 51%) Cardiovascular (n = 5, 16%) Artritis (n = 8, 25%)

*age = mean+standard deviation in years

Only 4 participants responded that they had engaged in any physical activity related to work. They reported performing activities of moderate intensity, which activities ranged from 0 to 2267 MET-mins/week. All the participants answered the questions related to transportation since all have to travel at least 3 days a week to receive treatment. Transportation by motor vehicle added up to an average of 60+40 minutes per day. Another mode of transportation was that which combines riding on a public bus and walking, with 7 participants reporting this combined use of public transportation and walking. These participants spent an average of 392+967 MET-mins/week on this activity.

Regarding daily home activities, 19 participants reported performing some chores around the house. The activities that they engaged in were moderate in intensity and lasted an average of 31+51 minutes. The total physical activity energy expenditure was an average of 1025+1856 MET-mins/week (median 200 MET-mins/week). Examples of those activities are sweeping/mopping the floor, folding clean clothes, raking leaves, gardening, and washing dishes. Furthermore, 12 participants answered that they engaged in some recreational physical activity. The activities of choice consisted mostly of

Table 2. Physical activity of the participants (n = 26)

Variable	Average (Standard Deviation)	Minimum	Maximum	Median	Q1=25	Q2=50	Q3=75	Q4=95
IPAQ Work METs*min*wk	151 (+516)	0	2267	0	0	0	0	1977
IPAQ Car Transportation (mins*day)	60 (+40)	9	137	51	30	51	105	134
IPAQ Walk Transportation METs*min*wk	392 (+968)	0	4158	0	0	0	346	3742
IPAQ Housework Total METs*min*wk	1025 (+1856)	0	7245	200	0	200	1531	6767
IPAQ Leisure Time Physical Activity METs*min*wk	111 (+169)	0	693	0	0	0	206	603
IPAQ Total METs*min*wk	1688 (+2250)	0	7245	544	68	544	2860	7151
IPAQ Sitting Time (mins/day)	454 (+293)	39	1200	388	272	388	710	1116

Table 3. Categorical Score of Total Physical Activity

Category	Definition*	Actual Range	Frequency of cases (n = 26)
Low	Does not meet criteria for moderate or vigorous	0-460 MET-mins/week	12**
Moderate	Achieves at least 600 MET-mins/week	627–895 MET-mins/week	3
		1572–2657 MET-mins/week	4
Vigorous	Achieves 3000 MET-mins/week	3471–7245 MET-mins/week	7

*Definitions of categorical values according to the Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire. **Adding the 5 cases excluded from the analysis, the total would then be 17 cases (n = 31).

recreational walks; some participants reported that they rode bicycles or walked in the mall. The total physical activity energy expenditure in leisure-time activities was an average of 111+167 MET-mins/week. The total physical activity energy expenditure for the all the categories from the IPAQ was an average of 1688+2250 MET-mins/week (median 544 MET-mins/week).

Finally, all participants answered the questions regarding time spent sitting. They reported that they sat for about 454+293 minutes per day (approximately 7.5 hours daily). A follow-up question regarding sitting time revealed that when they were not sitting, they were usually resting in bed. Table 3 shows the categorical score of total physical activity according to the definition in the IPAQ Guidelines and the number of cases, participants, in each category. There were 12 participants who were considered to have low physical activity levels (46%, n = 26). Next, 7 participants were classified as having moderate physical activity levels, and 7 were classified as having vigorous physical activity levels. An important observation is that those participants classified as having moderate and vigorous physical activity levels had significant variability in terms of total MET-mins/week of energy expenditure. Therefore, there were some participants who performed more and more varied types of activities than some of the others did.

Furthermore, the author wanted to determine whether there was a relationship between the amount of time since the beginning of hemodialysis treatment and total physical activity scores. The observation was that the 4 participants who were actively working had recently begun hemodialysis treatment. The author inferred that the longer patients were on hemodialysis, the less active they became. A Spearman's correlation test found a significant inverse relationship between the 2 variables ($p = -0.301$; $p<0.05$). In the analysis, the age of the participant was found not significant in relationship to the total physical activity scores.

Discussion

To our knowledge, this is the first study to report on the physical activity characteristics of ESRD patients in Puerto Rico who are receiving hemodialysis. It is important to emphasize that the individuals in this group of participants were not physically active before treatment for ESRD and that they became even more sedentary after hemodialysis treatment was initiated. They were working regular jobs when they were diagnosed with ESRD, and to be able to receive treatment, they resigned or retired from their jobs. Another interesting observation was that they spent significant portions of their days sitting (the other choice being lying in bed). Sitting is a sedentary behavior that includes sitting while commuting, workplace sitting, sitting while in a domestic environment, and sitting during leisure time. It has been categorized as a negative behavior since there is evidence that shows excessive sitting to have an impact on lipoprotein lipase activity (necessary for triglyceride uptake and HDL [good cholesterol] production) and reduced glucose uptake (32). In experimental conditions, sitting for 7 continuous hours is considered prolonged sitting and has been shown to have negative metabolic effects (33). Prolonged sitting time has been associated with premature cardiovascular and all-cause mortality, which association is independent of leisure-time physical activity and adiposity (33, 34). In 2012, Dungstan, Kingwell, Larsen, and colleagues conducted a study to determine whether breaking up prolonged sitting would have an effect on postprandial glucose and insulin levels. This group of investigators used a model of 7-hours uninterrupted sitting time as a baseline, mimicking a day of office work. Following this, they implemented 2 interventions. One consisted of interrupted sitting with light-intensity activity, and the other consisted of interrupted sitting with moderate-intensity activity. They found that breaking prolonged sitting time with short bouts of physical activity lowered postprandial glucose and insulin levels in overweight and obese individuals. The participants in our study spent an average of 7.5 hours per day sitting; therefore, we propose that similar metabolic processes develop in uninterrupted sitting. Excessive sitting may contribute to low physical function in this population.

Physical functional performance in our participants had significant variability. Four participants remained in the labor force, 19 worked around the house, and only 12 performed leisure-time physical activity; 7 did not perform any kind of physical activity (as defined by the IPAQ: work, housework, leisure time). Hence, the participants in this study, on average, did not perform all the activities that a person of their age and sex would normally perform in a typical day, such as work-related activities, housework (including yard work and car maintenance), family care or child raising, and leisure-time physical activities, among others. They engaged in some random physical activities but not consistently.

A similar study was conducted in China, also using the IPAQ (35). Li, Li, and Fan (35) found that the reported physical activities in their group were mostly related to transportation (walking) and housework, with none of the members of the sample group being engaged in any kind of vigorous activity. The authors concluded that their participants were minimally active and that the types of physical activities in which they engaged were limited. Therefore, they recommended more physical-activity counseling for this population. The findings of Li, Li, and Fan are similar to those of our study, including the great variability among patients in terms of physical activity. In our study, the total physical-activity score was inversely related to the time since the beginning of dialysis, but was not so related with the age of the participant.

In this study, the author describes the physical inactivity in ESRD patients receiving hemodialysis, and the significant variability in physical activity among them. Moreover those participants who had been on hemodialysis the longest tended to be the most sedentary, regardless of age. Therefore, it is important to raise awareness among, educate and assess, and, if warranted, recommend physical activity to chronic kidney disease patients, including those with end-stage renal disease who are receiving hemodialysis. The limitations of the study were that 1) the measures of physical activity were self-reported, 2) no other physiological variables were measured, 3) it had a small number of participants, and 4) only 1 dialysis center (in the San Juan metropolitan area) participated. The assessment of physical activity using self-reports/questionnaires is an indirect measure, and such reports may contain errors in terms of recalling the intensity, duration, or both of any given activity. Moreover, using a physical activity monitor device (accelerometer, pedometer) would have resulted in a precise quantification of the activity. Another limitation of our study is that no other physiological variables were measured (e.g., oxygen consumption, blood pressure, heart rate). The oxygen consumption (VO2 Peak) would have given us an indication of each participant's cardiorespiratory fitness and health. The sample size of our study was small and as such represents a statistical weakness. Finally, our participants were recruited from 1 dialysis center in the metropolitan area; the recruited patients might not be strictly representative of all dialysis patients in Puerto Rico. Our recommendations for future research are to design and evaluate interventions that promote increases in physical activity and to investigate the relationship between the levels of physical activity and the clinical outcomes of ESRD patients receiving hemodialysis in Puerto Rico.

Resumen

Objetivo: El efecto positivo del aumento en actividad física en algunos marcadores clínicos en estas poblaciones de enfermedades crónicas se ha evidenciado, incluyendo enfermedad renal crónica. Por lo tanto, el propósito de ésta investigación era describir al paciente renal recibiendo hemodiálisis y sus niveles de actividad física. Métodos: Los pacientes fueron reclutados de la unidad renal del Hospital Universitario en San Juan. Las variables de interés eran: 1) información socio-demográfica y estado de salud, y 2) niveles y patrones de actividad física. Resultados: Participaron 31 pacientes con enfermedad renal crónica en hemodiálisis (17 hombres, 14 mujeres). La edad promedio de los participantes fue 54 + 17 años. Ochenta y siete por ciento (87%) contestaron que no eran físicamente activos antes de comenzar el tratamiento de hemodiálisis. Solo 4 participantes se mantenían trabajando, realizando actividades con un gasto entre 0-2267 MET-mins/semana. Diecinueve participantes reportaron realizar algunas tareas en el hogar. Actividades física del hogar tuvieron un gasto de 1025+1856 MET-mins/semana (mediana 200 MET-mins/semana). Actividad física recreacional obtuvo en promedio un gasto de 111+167 MET-mins/semana. El gasto total de todas las actividades físicas que contiene el IPAQ (sus siglas en inglés) fue 1688+2250 MET-mins/semana (mediana 544 MET-mins/semana). Los participantes permanecen sentados un promedio de 454+293 minutos/día (aproximadamente 7.5 horas diarias). La prueba de correlación de Spearman encontró una relación inversa entre años recibiendo hemodiálisis y actividad física total, independiente de la edad ($p = -0.301$; $p<0.05$). Conclusión: En este estudio, la autora describió los niveles bajos de actividad física que ejecutan un grupo de pacientes renales recibiendo hemodiálisis. Además, demostró la variabilidad significativa

que existe entre los participantes en cuanto a la ejecución física. Los pacientes que han estado recibiendo hemodiálisis por más tiempo son los más sedentarios independientemente de su edad. Por lo tanto, es importante concienciar, educar, evaluar y recomendar actividad física para los pacientes de enfermedad renal crónica incluyendo aquellos que se encuentren en el estadio final y reciben hemodiálisis.

Acknowledgments

The author would like to thank Dr. Farah Ramirez and Dr. Jose Agosto for their comments and suggestions about this manuscript; Mr. Joan Modesto for his assistance collecting the data; and Dr. Rafael Burgos Calderon; and the staff and patients of the renal unit of Hospital Universitario, Centro Medico, for their support.

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