International Urology and Nephrology (2019) 51:1249–1260
https://doi.org/10.1007/s11255-019-02179-1

NEPHROLOGY - ORIGINAL PAPER

Attitudes of hemodialysis patients, medical and nursing staff towards patients' physical activity

Vassiliki Michou[1] · Evangelia Kouidi[1] · Vassilios Liakopoulos[2] · Evangelia Dounousi[3] · Asterios Deligiannis[1]

Received: 18 October 2018 / Accepted: 21 May 2019 / Published online: 3 June 2019

Abstract

Purpose Patients with end-stage renal disease (ESRD) seem to have a negative attitude towards physical activity, which is mainly favored by the lack of counseling provided by the medical and nursing staff. The aim of this study was to investigate the attitudes of both ESRD patients and medical staff on the participation and promotion of physical activity and identify the obstacles that discourage patients' involvement in intervention programs.

Study design Subjective assessment questionnaires and the International Physical Activity Questionnaire were administrated to hemodialysis patients and medical staff, to investigate the association between patient's barriers to physical activity, the total intensity level of physical activity, and attitudes of both ESRD patients and medical staff on the participation and promotion of physical activity.

Results A total of 103 ESRD patients (61 men, 59.2%), 20 nephrologists (12 men, 60.0%), and 72 nurses (61 women, 84.7%) participated in the study. Most commonly reported patient's barriers were fatigue on dialysis (97.4%) and non-dialysis days (55.1%). Healthcare staff showed positive attitude towards renal rehabilitation exercise programs. However, most of physicians (85.0%) and nurses (83.3%) did not have previous experience with interventional exercise rehabilitation programs. Binary logistic regression revealed significant association between patients' inactivity, demographic data, and barriers towards physical activity, such as fatigue and pain in dialysis and non-dialysis days ($p < 0.05$), family's and physician's concern ($p < 0.05$), too many medical problems ($p < 0.05$), the fear of getting hurt ($p = 0.01$), and unwillingness for exercise ($p < 0.05$). Interestingly, healthcare staff's negative attitudes toward patient's physical activity seem to be strongly associated with patient's inactivity status.

Conclusion Healthcare staff negative attitudes and multiple related barriers especially fatigue on dialysis and non-dialysis days, towards ESRD patient's physical activity, suppress desire for exercise and active patients' status, leading them to abstain from it.

Keywords Chronic kidney disease · Counseling · Hemodialysis · Physical activity

Introduction

In the general population, lifestyle changes that increase levels of physical activity lead to lower morbidity and mortality. Current guidelines recommend that healthy people perform moderate physical activity in most days of the week [1].

Patients with ESRD are less active, have lower levels of physical activity, and are increasingly adopting a sedentary life, compared to healthy individuals [1]. Several pioneering studies on the effects of exercise training in hemodialysis (HD) patients have shown that increased physical activity can improve the level of their quality of life and, potentially, clinical outcomes [2–6]. Despite the ever-increasing proven benefits of exercise, HD patients seem to have a negative

✉ Vassiliki Michou
vasilikimichou@yahoo.gr

[1] Sports Medicine Laboratory, School of Physical Education and Sport Science, Aristotle University, Thessaloniki, Greece

[2] Division of Nephrology and Hypertension, 1st Department of Internal Medicine, Medical School, Aristotle University, AHEPA Hospital, Thessaloniki, Greece

[3] Department of Nephrology, Medical School University of Ioannina, Ioannina, Greece

attitude towards physical activity. It has been supported that certain modifiable factors, such as lack of time, concern about the risks of physical exercise, and lack of motivation by nurse and medical staff, may contribute to the sedentary habits of many patients undergoing hemodialysis [1, 7].

Recent studies have evaluated the knowledge and attitudes of medical and nursing staff about the benefits of physical activity in HD patients, as well as their role to promote exercise training in these patients as complementary method in total therapy [8–13]. However, the studies are limited with respect to sample, design, and measurement. Regarding sample and design, most studies were conducted at a single center with little patient diversity (i.e., gender, age, and socio-economic status). In addition, physicians and patients who responded to surveys about renal rehabilitation are likely different than non-responders as they have more positive attitudes about physical activity.

The present study was designed (a) to assess the levels of physical activity of patients and medical staff of different dialysis centers, (b) to investigate the attitudes of both HD patients and medical staff on the participation and promotion of physical activity, and (c) to identify the obstacles that discourage the participation of patients in renal exercise rehabilitation programs.

Patients and methods

Participants

Public and private dialysis units of the Prefecture of Thessaloniki and Ioannina in Greece were invited to participate in the present research. A total of 200 patients, 80 nurses, and 30 nephrologists were informed about the purpose of the survey and the process of completing the questionnaires in the field of dialysis unit and few of them volunteered to participate in the study. Inclusion criteria for patients included being in hemodialysis treatment for at least 1 year and over 20 years old. Inclusion criteria for nurses and Nephrologists included previous work experience more than 4 months in hemodialysis units. There were no further exclusion criteria.

All participants gave written informed consent prior to the study participation. The present study has been approved by the Human Research and Ethics Committee of the AHEPA University Hospital and the Aristotle University of Thessaloniki Ethics Committee. The investigation started in December of 2016 and ended in June of 2017.

Study design

For the correct completion of the questionnaires, the same researcher was present to inform and guide the participants in the questionnaire completion process. It is worth noting that in the very few cases of patients who were not able to fill in the questionnaires by themselves, the questionnaires were completed by the investigator herself, who previously had worded the appropriate instructions, and inquired and recorded the respondents' answers to each questionnaire.

Subjective evaluation questionnaires

The patient's questionnaire was divided in two parts: (a) the first part was related to their socio-demographic data (gender, age, place of residence, education, and work) and data on ESRD (disease duration, previous transplantation, and associated symptoms), and (b) the second part consisted of questions concerning attitudes and possible barriers related to their participation in physical activity. Those questions were based on similar questionnaires that have been used by Delgado and Johansen [14] and White and Grenyer [15]. Delgado and Johanssen questionnaire [14] consists of 22 questions that represent HD patients' possible barriers towards physical activity. We dichotomized patients, according to International Physical Activity Questionnaire (IPAQ), in active and inactive HD patients, and we investigated how important are those barriers to physical activity both in active and inactive patients. More specifically, we considered active HD patients those who belong in two (minimally active) or three (strongly active) IPAQ categories and inactive HD patients those who belong in category 1 (Inactive).

The medical's staff questionnaire was structured in three parts: (a) the first part was related to their demographic data (age, sex, occupation, workplace, and previous work experience), (b) the second part recorded their attitudes regarding the physical activity of the ESRD patients, and (c) the third part recorded their attitudes regarding the exercise rehabilitation programs that might be available in their dialysis units. Those questionnaires were based on previously used questionnaires, which have been contacted by researchers who have done similar studies in the ESRD population [8, 13, 16]. IPAQ questionnaire was also given to healthcare staff. Therefore, we have also dichotomized, same as above, nurses, and nephrologists in active and inactive persons.

IPAQ—International Physical Activity Questionnaire

Apart from recording the attitudes of patients and medical staff, the level of physical activity of all participants was also evaluated. For this purpose, the IPAQ was used in its short version. This questionnaire is a valid and reliable measuring tool of physical activity, it has been validated for Greek population in 2009 by Papathanassiou et al. [17], and it has been used by several researchers for the group of dialysis patients. More specifically, in the international literature, for the last 4 years, there is a total of eight research articles,

in the population of ESRD patients that undergoing haemodialysis treatment, which measure physical activity levels. Three of them use the short version of IPAQ [18–20] and five research articles use the long version of IPAQ, in many different languages [21–25]. Most of them showed good reliability coefficients, and only a minority of these articles refer that IPAQ may not be representative in this particular population. IPAQ can been downloaded by the official IPAQ website [26]. It is divided into eight individual parts and includes questions about the time spent for some physical activity in the last 7 days. It also includes questions about activities that can be done at work, transportation, housework, gardening, and in leisure time, for entertainment, exercise, or sports [17, 27, 28].

The short version of the IPAQ evaluates three types of activity: walking, moderate intensity, and vigorous intensity activities recording the frequency (days per week) and the duration (minutes per day) for each type of activity separately. Calculation of the total score requires summation of the duration (in min) and frequency (days) of walking, moderate intensity, and vigorous intensity activities. Furthermore, there is another measure of the level of activity that can be calculated by weighing each type of activity according to its energy requirements defined in METs (METs are multiples of the resting metabolic rate) to yield a score in MET minutes.

According to the IPAQ questionnaire scores, there are three levels of physical activity that consider the total physical activity in all sectors (work, homework, transportation, and entertainment):

- Inactive (Category 1): This is the lowest level of physical activity. People who do not meet the criteria for categories 2 or 3 are considered insufficiently active.
- Minimally active (Category 2): One of the following criteria must be met: (a) 3 or more days per week of vigorous activity with at least 20 min per day; or (b) 5 or more days of moderate intensive activities or walking for at least 30 min per day; or (c) 5 or more days of any combination of walking, moderate or vigorous activity. People in this category achieve at least 600 MET per min/week.
- Strongly active (Category 3): One of the following criteria: (a) participation in vigorous activities for at least 3 days per week, achieving a minimum of 1500 METs per week or (b) participation for 7 days or more in any combination of walking, moderate or vigorous activity, scoring at least 3000 MET/min.

Charlson Comorbidity Index

Moreover, to evaluate ESRD patient's mortality, the Charlson Comorbidity Index (CCI) has been used. The CCI is a worldwide method that allows medical researchers to predict mortality by classifying comorbidities in many disease subgroups, such as cancer, renal disease, and intensive care [29]. Although a few studies have evaluated CCI validity in ESRD patients, ESRD patients consider to be a high mortality subgroup, as the mortality rate in these patients is extremely high with a high prevalence of comorbidities [30].

Statistical analysis

To analyze the results of the present survey, descriptive statistics were used to evaluate the frequencies, as the data were quantitative. For the evaluation of correlation degree between the physical activity patients' level (active or inactive) and barriers towards physical activity and in what degree any negative attitudes on the whole healthcare are associated with patient's inactivity, binary logistic regression model for the estimation of the degree and strength of the relationships between the above variables was applied. A two-tailed $p \leq 0.05$ was considered statistically significant, and for the statistical analysis, the statistical software IBM SPSS Statistics-Version 25 was used.

Results

Descriptive statistical analysis

According to subjective evaluation questionnaires, 103 hemodialysis patients, 72 nurses specializing in renal nursing, and 20 nephrologists participated in this study (Tables 1, 2). Sixty-one of the ESRD patients (59.2%) were male, with a mean age of 60.1 ± 19.8 years and 31 (30.0%) of them were older than 70 years old. The 69.9% were dialyzed through an arteriovenous fistula or graft (AVF or AVG), with a mean CCI of 7.2 ± 3.5, 68.9% of them were urban residents, 53.4% of them were dialyzed in a private unit, 39.8% of them were dialyzed in a public unit, 32.0% were primary school graduates, 46.6% did not work, and 35.0% have been retired. Of them, 44.7% were on dialysis from 2 to 5 years and only 16.5% had undergone a previous kidney transplant. Interestingly, only 2.9% of HD patients participated in an interventional exercise program, using a bicycle ergometer, which is provided by the University Dialysis Unit of Thessaloniki.

In the nursing population, 11 (15.3%) were males, with a mean age of 26.4 ± 19.1 years, and in the physician's population, 12 (60.0%) were males, with an average age of 38.0 ± 18.8 years. The majority of nephrologists (55.0%) work in University Public Hospital and most of the dialysis nurses (54.1%) work in a private clinic. Both of nephrologists and nurses have a previous service between 5 and 15 years (Table 2).

Table 1 Patients' demographic characteristics and associated clinical variables

	Patients
Subjects	103
Sex (male/female)	61/42
Age (years)	60.1 ± 19.8
Place of residence	
Rural area	10
Suburban area	22
Urban area	71
Type of haemodialysis unit	
Private unit	55
Public unit	41
Public university unit	7
Participation in the interventional exercise program during dialysis treatment	
Yes	3
No	100
Education	
Primary education	33
Secondary education	31
Higher education	28
No education	11
Employment status	
Unemployed	54
Employed	13
Retirees	36
Dialysis access	
Arteriovenous fistula or graft (AVF or AVG)	72
Central venous catheter	31
HD vintage (years)	
1–2	9
2–5	46
5–10	27
10–15	5
15–20	6
> 20	10
Previous transplantation	
Yes	17
No	86
Charlson Comorbidity Index	7.2 ± 3.5
Comorbidities/associated symptoms	
Diabetes	25
Hypertension	40
Reduced amount of urine	65
Breathing difficulty	14
Cramps and convulsions	43
Fatigue and weakness	60
Somnolence	16
Nausea and vomiting	7
Peripheral vascular disease	25
Heart failure	31
COPD	21

COPD chronic obstructive pulmonary disease

Table 2 Medical and nursing staff's demographic characteristics

	Nephrologists	Nurses
Subjects	20	72
Sex (male/female)	12/8	11/61
Age (years)	38.0 ± 18.8	26.4 ± 19.1
Workplace		
University public hospital	11	23
Public hospital	4	10
Private clinic	5	39
Previous service		
4 months to 1 year	–	5
1–2 years	–	7
2–5 years	4	8
5–15 years	11	23
15–20 years	4	11
> 20 years	1	17

According to the analysis of the results of the International IPAQ questionnaire, HD patients spent during a normal week in average:

- 1 day per week on vigorous physical activities, with a total duration of 7 min per day,
- 2 days per week in moderate physical activity, 23 min per day,
- 4 days walking for more than 10 min, walking a total of 31 min within the week, and
- 6 h in a sitting position per day.

Moreover, according to the level of physical activity at work, transportation, housework, and in leisure time, for entertainment, exercise, or sports, findings of this article found that the majority of ESRD patients had low intensity of physical activity at work (10 patients, 76.9%), at transportation (56 patients, 54.3%), at housework (66 patients, 64%), and in leisure time (65 patients, 63.1%). In total, 2 patients were highly active, 35 were minimally active, and 66 were inactive. According to the above and based on the IPAQ score in MET minutes per week, which equals 649.2 MET, patients with ESRD were minimally active (Table 3).

The results for nephrologists:

Table 3 Patient's, nurse's, and nephrologist's physical activity level according the IPAQ

Category	Highly active	Minimally active	Inactive
ESRD patients	2 (1.9%)	35 (33.9%)	66 (64.0%)
Dialysis nurses	36 (50.0%)	27 (37.5%)	9 (12.5%)
Nephrologists	1 (5.0%)	5 (25.0%)	14 (70.0%)

- Physicians devote, on average, 1 day per week to vigorous physical activities, with a total duration of 25 min per day,
- 3 days per week in moderate physical activity, 38 min per day,
- 4 days of walking for more than 10 min, walking a total of 35 min in a week and
- 6 h per day in a sitting position within a week.

According to the level of physical activity at work, transportation, housework, and in leisure time, for entertainment, exercise, or sports, findings of this article found that the majority of nephrologists had low intensity of physical activity at work (15 physicians, 75%), at transportation (15 physicians, 75%), at housework (14 physicians, 70%), and in leisure time (16 physicians, 80%). In total, 1 nephrologist was highly active, 6 were minimally active, and 13 were inactive. Therefore, the score in MET minutes per week, equals with 1052 METs, and nephrologists considered to be minimally active (Table 3).

The results of IPAQ questionnaire for nurses have shown that:

- Nurses spent, in average, 2 days per week on vigorous physical activities, 30 min per day,
- 4 days per week in moderate physical activity, 51 min per day,
- 5 days walking for more than 10 min, walking a total of 37 min within a week, and
- 3 h per day in a week in a sitting position.

According to the level of physical activity at work, transportation, housework, and in leisure time, for entertainment, exercise, or sports, findings of this article showed that the majority of dialysis nurses had high intensity of physical activity at work (49 nurses, 68%) and at housework (33 nurses, 45.8%) and median intensity of physical activity at leisure time (32 nurses, 45.8%) and transportation (21 nurses, 29.1%). In total, 36 dialysis nurses were highly active, 27 were minimally active, and 9 were inactive. The score in MET minutes per week was equal to 1906.5 METs. Thus, nurses are considered to be highly active (Table 3).

The most prevalent obstacle encountered by ESRD patients in incorporating physical activity (Table 4) was fatigue, especially on dialysis days (73.8%). Other frequent reported barriers were the feeling of helplessness (37.9%) and the fear of getting hurt (36.9%). These two barriers were positively correlated to daytime fatigue on days without hemodialysis (41.7%).

Table 4 Patients' barriers to physical activity

	Patients (*n*) Percent of cases (%)
No place to exercise	14 (13.6%)
No exercise partner	13 (12.6%)
Fatigue on dialysis days	76 (73.8%)
Fatigue on non-dialysis days	43 (41.7%)
Pain in dialysis days	25 (24.3%)
Pain in non-dialysis days	21 (20.4%)
Lack of time in dialysis days	28 (27.2%)
Lack of time in non-dialysis days	17 (16.5%)
Too many medical appointments	6 (5.8%)
I do not want to exercise	33 (32.0%)
Feeling too old	30 (29.1%)
Shortness of breath	14 (13.6%)
Fear of getting hurt	38 (36.9%)
Sadness	23 (22.3%)
Feeling of helplessness	39 (37.9%)
Inability to travel	32 (31.1%)
Too many medical problems	36 (35.0%)
Family concern	30 (29.1%)
Physician concern	27 (26.2%)
Chest pain	4 (3.9%)
Amputation	4 (3.9%)
Ulcers on legs and feet	5 (4.9%)

The questionnaire concluded Yes and No answers. Statistical analysis was made by dichotomizing patients answers and in the table tabulated the value 1 = Yes

Analyzing further, 35.0% of the patients responded that they had many accompanying medical problems and some symptoms, such as pain, foot, and leg sores, difficulty in breathing, etc. The patients reported also that they did not want to exercise (32.0%), they were unable to travel (31.1%), they felt very old (29.1%), and they had no support from their family and attending physician (29.1% and 26.2%, respectively).

All nephrologists and almost all dialysis nurses believed that physical activity is beneficial for both the general population, as well as for HD patients (Table 5). However, 44.4% of physicians and 30.0% of nurses seemed to be particularly concerned about the possible risks of exercise in ESRD patients. Moreover, 70.0% of nephrologists and 72.2% of dialysis nurses believed that hemodialysis patients would increase their physical activity levels if they were advised to do so, and 40% of doctors and 62.5% of nurses reported on having time to discuss about the benefits of exercise with HD

Table 5 Medical and nursing staff's attitudes regarding CKD patient's physical activity

	Nephrologists *n* (%)	Nurses *n* (%)
Physical inactivity is an important risk factor for the health of the general population	20 (100.0%)	71 (98.6%)
Increasing physical activity is beneficial for most people	20 (100.0%)	70 (97.2%)
Physical activity is beneficial for hemodialysis patients	20 (100.0%)	70 (97.2%)
I am worried about the risks that exercise may involve in hemodialysis patients	6 (30.0%)	32 (44.4%)
I believe that most hemodialysis patients would increase levels of physical activity if they were advised to do so	14 (70.0%)	52 (72.2%)
I have time to talk to patients about physical activity	8 (40.0%)	45 (62.5%)
I believe that hemodialysis patients are interested in the subject of physical activity	6 (30.0%)	20 (27.8%)
I think exercise is important for CKD (as important as it is for other medical problems)	19 (95.0%)	67 (93.1%)
I believe it is the role of the physician/nurse to advise hemodialysis patients on physical activity	18 (90.0%)	56 (77.8%)
I feel comfortable with discussing the issue of physical activity with patients	19 (95.0%)	57 (79.2%)
Our patients often ask about physical activity	3 (15.0%)	12 (16.7%)
We often advise	4 (20.0%)	26 (36.1%)
Often, they ask, and we advise	5 (25.0%)	29 (40.3%)
Only for nephrologists		
We often prescribe	–	–
We often provide written material	–	–
They often refer to us	–	–
We often provide exercise equipment	1 (5.0%)	–

The questionnaire concluded Yes and No answers. Statistical analysis was made by dichotomizing patients answers and in the table tabulated the value 1 = Yes

This questionnaire is based on similar questionnaires that have been used by Fiaccadori et al. [8], Delgado and Johansen [14], and White and Grenyer [15]

patients. On the other hand, 70.0% and 72.2% of medical and nursing staff believed that ESRD patients are not interested in the inclusion of physical activity in their daily life, and 85.0% of nephrologists and 83.3% of dialysis nurses had been rarely asked about it by patients.

Interestingly, 85.0% of physicians and 83.3% of nurses did not have any experience with an interventional exercise rehabilitation program. Finally, 95.0% and 95.8%, of nurses and nephrologists, respectively, did not provide any information brochure about the benefits of physical activity to their patients, while, at the same time, 80.0% of physicians and 73.6% of dialysis nurses did not refer patients for therapeutic exercise to specialists (Table 6).

Multivariate analysis based on binary logistic regression model showed that male patients' sex (OR 6.0, 95% 0.4–0.7, $p < 0.001$), age older than 70 years (OR 5.1, 95% 0.3–0.6, $p < 0.001$), low education level (OR 3.7, 95% 0.3–0.4, $p < 0.001$), previous transplantation (OR 1.4, 95% 0.0–0.2, $p < 0.001$), HD vintage (OR 2.0, 95% 0.1–0.2, $p < 0.001$), and not participating in an interventional exercise program during dialysis session (OR 0.6, 95% 0.0–0.0, $p = 0.02$) were positively and independently associated with inactivity in ESRD patients. More specifically, results showed that the odds for inactive ESRD patients' status were 6.0 times greater for males as opposed to females, 5.1 times greater for patients older than 70 years against younger patients, 1.4 times greater for those who have undergone a previous kidney transplantation, 2.0 times greater for those who were on dialysis treatment between 2 and 5 years, 3.7 times greater for patients that had a low educational level, and 0.6 times greater for those who did not participated in an interventional exercise program during dialysis session. Other patient's demographic data, such as the use of arteriovenous fistula or graft as dialysis access (OR − 5.1, 95% − 0.6 to − 0.3, $p < 0.001$), patient's CCI (OR − 0.1, 95% 0.7–0.9, $p = 0.04$), living in a residential area (OR − 4.1, 95% 0.0–0.8, $p = 0.01$), and unemployment status (OR − 7.8, 95% − 0.9 to − 0.5, $p < 0.001$), were negatively and independently associated with inactive ESRD patients (Table 7).

Barriers towards physical activity, such as fatigue on dialysis (OR 4.8, 95% 0.2–0.6), $p < 0.001$) and non-dialysis days (OR 8.6, 95% 0.7–0.9, $p < 0.001$), were positively and independently associated with inactivity in ESRD patients. In contrast, barriers such as no place to exercise (OR − 2.1, 95% 0.0–0.4, $p = 0.02$), no partner to exercise (OR − 2.6, 95% 0.0–0.3, $p = 0.01$), pain on dialysis (OR − 3.4, 95% 0.0–0.1, $p < 0.001$) and non-dialysis days (OR − 2.5, 95% 0.0–0.2, $p < 0.001$), lack of time on dialysis (OR − 2.6, 95% 0.0–0.1, $p < 0.001$) and non-dialysis days (OR − 3.0, 95% 0.0–0.2, $p < 0.001$), unwillingness

Table 6 The attitude of medical staff towards existing or non-existing exercise programs

	Nephrologists *n* (%)	Nurses *n* (%)
In the dialysis unit where you are working, is there a current rehabilitation program for CKD patients?	17 (85.0%)	60 (83.3%)
Do you have brochures about daily exercise available for CKD patients?	19 (95.0%)	69 (95.8%)
Do you have any exercise videos available for CKD patients?	20 (100.0%)	71 (98.6%)
Do you provide information or make referrals to the community for exercise programs especially designed for these patients?	20 (100.0%)	47 (65.2%)
Have you asked each patient individually whether they want to participate in physical activities?	16 (80.0%)	66 (91.7%)
Do you have in the dialysis unit where you work the right equipment for exercise?	17 (85.0%)	59 (82.0%)
Do you regularly refer your patients for therapeutic exercise to specialists?	16 (80.0%)	53 (73.6%)
Has the health status of each patient been assessed for changes that could affect his or her physical functioning?	13 (65.0%)	51 (70.8%)
Do you provide any type of exercise program outside the dialysis unit that includes assessment and personalized design?	18 (90.0%)	70 (97.2%)
Do you monitor the outcome, or the expected outcomes associated with the efforts to exercise of your CKD patients?	15 (75.0%)	58 (80.5%)
Have you supported or rewarded your patients' efforts to improve their physical functioning?	8 (40.0%)	14 (19.4%)
Do you regularly evaluate your patients' overall functional status?	10 (50.0%)	31 (43.0%)
Do you regularly assess patient satisfaction with the levels of functionality or recovery?	11 (55.0%)	36 (50.0%)

The questionnaire concluded Yes and No answers. Statistical analysis was made by dichotomizing patients answers and in the table tabulated the value 2 = No

Table 7 Logistic regression between patient's demographic data and physical inactivity status according to IPAQ

Variable	Inactive patients [estimate 95% CI]	*p* value
Male patient sex	6.0 (0.4 to 0.7)	< 0.001
Age bigger than 70 years old	1.2 (0.3 to 0.6)	< 0.001
Arteriovenous fistula or graft dialysis access	− 5.1 (− 0.6 to − 0.3)	< 0.001
Living in a residential area	− 4.1 (0.0 to 0.8)	0.01
Low educational level	3.7 (0.3 to 0.4)	< 0.001
Previous transplantation	1.4 (0.0 to 0.2)	< 0.001
HD vintage (2–5 years)	2.0 (0.1 to 0.2)	< 0.001
Unemployment status	− 7.8 (− 0.9 to − 0.5)	< 0.001
Charlson Comorbidity Index (CCI)	− 0.1 (0.7 to 0.9)	0.04
Unparticipating in an interventional exercise program during dialysis session	0.6 (0.0 to 0.0)	0.02

Correlation is significant at the 0.05 level (two-tailed)

for exercise (OR − 4.5, 95% 0.0–0.0, $p < 0.001$), feeling too old (OR − 4.0, 95% 0.0–0.0, $p < 0.001$), shortness of breath (OR − 2.1, 95% 0.0–0.4, $p = 0.02$), fear of getting hurt (OR − 7.0, 95% 0.0–0.0, $p = 0.01$), sadness (OR − 3.2, 95% 0.0–0.1, $p < 0.05$), feeling of helplessness (OR − 6.6, 95% 0.0–0.0, $p = 0.01$), inability to travel (OR − 4.9, 95% 0.0–0.0, $p < 0.05$), too many medical problems (OR − 4.5, 95% 0.0–0.0, $p < 0.001$), family's concern (OR − 4.0, 95% 0.0–0.0, $p = 0.0021$), and physician's concern (OR − 3.2, 95% 0.0–0.1, $p = 0.0012$), were negatively and independently associated with inactivity in ESRD patients (Table 8).

No association has been found between too many medical appointments (OR − 1.3, 95% 0.0–1.4, $p = 0.12$), chest pain (OR 5.3, 95% 0.1–17.0, $p = 0.64$), amputation (OR − 1.7, 95%, 0.0–1.7, $p = 0.13$), and ulcers on legs and feet (OR − 2.0, 95% 0.0–1.1, $p = 0.07$) (Table 8).

Our results showed that nurse's perceptions such as "no time to talk to patients about physical activity" (OR 2.0, 95% 0.1–0.1, $p = 0.01$), perceptions that "ESRD patients are not interested in the subject of physical activity" (OR 6.4, 95% 0.1–5.0, $p = 0.01$), "physical activity is not important for ESRD patients" (OR 5.8, 95% 0.3–4.0, $p = 0.03$) and "it is not the role of dialysis nurses to advise hemodialysis patients on physical activity" (OR 5.0, 95% 0.4–5.6, $p = 0.05$), were positively and independently associated with inactivity in ESRD patients (Table 9).

Similarly, findings of this study showed that nephrologist's perceptions such as "I do not believe that most

Table 8 Logistic regression between patient's barriers towards physical activity and physical inactivity status according to IPAQ

	Inactive patients [estimate 95% CI]	Level of statistical significance (p)
No place to exercise	− 2.1 (0.0 to 0.4)	0.02
No exercise partner	− 2.6 (0.0 to 0.3)	0.01
Fatigue on dialysis days	4.8 (0.2 to 0.6)	< 0.001
Fatigue on non-dialysis days	8.6 (0.7 to 0.9)	< 0.001
Pain in dialysis days	− 3.4 (0.0 to 0.1)	< 0.001
Pain in non-dialysis days	− 2.5 (0.0 to 0.2)	< 0.001
Lack of time in dialysis days	− 2.6 (0.0 to 0.1)	< 0.001
Lack of time in non-dialysis days	− 3.0 (0.0 to 0.2)	< 0.001
Too many medical appointments	− 1.3 (0.0 to 1.4)	0.12
I do not want to exercise	− 4.5 (0.0 to 0.0)	< 0.001
Feeling too old	− 4.0 (0.0 to 0.0)	< 0.001
Shortness of breath	− 2.1 (0.0 to 0.4)	0.02
Fear of getting hurt	− 7.0 (0.0 to 0.0)	0.01
Sadness	− 3.2 (0.0 to 0.1)	< 0.001
Feeling of helplessness	− 6.6 (0.0 to 0.0)	0.01
Inability to travel	− 4.9 (0.0 to 0.0)	< 0.001
Too many medical problems	− 4.5 (0.0 to 0.0)	< 0.001
Family concern	− 4.0 (0.0 to 0.0)	0.21
Physician concern	− 3.2 (0.0 to 0.1)	0.12
Chest pain	5.3 (0.1 to 17.0)	0.64
Amputation	− 1.7 (0.0 to 1.7)	0.13
Ulcers on legs and feet	− 2.0 (0.0 to 1.1)	0.07

This questionnaire is based on similar questionnaires that have been used by Delgado and Johansen [14] and White and Grenyer [15]

Table 9 Logistic regression for nursing staff's negative attitudes regarding ESRD patient's physical activity and patient's physical inactivity status according to IPAQ

Nurses negative attitudes	Inactive patients [estimate 95% CI]	p value
I am not worried about the risks that exercise may involve in hemodialysis patients	− 1.2 (1.6 to 12.8)	0.72
I do not believe that most hemodialysis patients would increase levels of physical activity if they were advised to do so	− 1.0 (0.0 to 2.1)	0.25
I have not time to talk to patients about physical activity	2.0 (0.1 to 0.1)	0.01
I do not believe that hemodialysis patients are interested in the subject of physical activity	6.4 (0.1 to 5.0)	0.01
I do not think exercise is important for ESRD (as important as it is for other medical problems)	5.8 (0.3 to 4.0)	0.03
I do not believe it is the role of the physician/nurse to advise hemodialysis patients on physical activity	5.0 (0.4 to 5.6)	0.05
I do not feel comfortable with discussing the issue of physical activity with patients	− 3.3 (0.9 to 11.6)	0.56
Our patients do not often ask about physical activity	4.7 (0.4 to 3.5)	0.24
We do not often advise	4.9 (0.4 to 3.3)	0.19

Correlation is significant at the 0.05 level (two-tailed)

hemodialysis patients would increase levels of physical activity if they were advised to do so" (OR − 8.3, 95% 0.8–1.1, $p < 0.001$), "I do not have time to talk to patients about physical activity" (OR − 1.6, 95% − 1.1 to − 0.5, $p < 0.001$), "I do not believe that hemodialysis patients are interested in the subject of physical activity" (OR − 3.5, 95% − 0.3 to 0.3, $p < 0.001$), "our patients do not often ask about physical activity" (OR − 3.5, 95% − 1.1 to 1.1, $p < 0.001$), "we do not often advise" (OR − 2.8, 95% − 1.4 to 1.4, $p = 0.0014$), and "often, they do not ask, and we do not advise" (OR − 4.6, 95% − 1.5 to 1.5, $p = 0.03$) were negatively and independently associated with inactive ESRD patients (Table 10).

Table 10 Logistic regression between nephrologists' negative attitudes regarding ESRD patient's physical activity and patient's physical inactivity status according to IPAQ

Nephrologists' negative attitudes	Inactive patients [estimate 95% CI]	*p* value
I do not believe that most hemodialysis patients would increase levels of physical activity if they were advised to do so	− 8.3 (0.8 to 1.1)	< 0.001
I have not time to talk to patients about physical activity	− 1.6 (− 1.1 to − 0.5)	< 0.001
I do not believe that hemodialysis patients are interested in the subject of physical activity	− 3.5 (− 0.3 to 0.3)	< 0.001
Our patients do not often ask about physical activity	− 3.5 (− 1.1 to 1.1)	< 0.001
We do not often advise	− 2.8 (− 1.4 to 1.4)	0.14
Often, they do not ask, and we do not advise	− 4.6 (− 1.5 to 1.5)	0.03
We do not often provide exercise equipment	− 3.6 (− 1.4 to 0.7)	0.47

Correlation is significant at the 0.05 level (two-tailed)

Table 11 Logistic regression between nurse's total high intensity of physical activity, according to IPAQ, and demographic data

	Nurses' IPAQ [estimate 95% CI]	*p* value
Female nurse's sex	5.1 (0.0–0.0)	0.6
Age	4.2 (0.7–0.9)	< 0.001
Workplace (private clinic)	2.9 (0.0–0.0)	0.04
Previous service (5–15 years)	1.4 (0.0–0.0)	0.46

Correlation is significant at the 0.05 level (two-tailed)

Table 12 Logistic regression between nephrologist's total low intensity of physical activity, according to IPAQ, and demographic data

	Nephrologist's IPAQ [estimate 95% CI]	*p* value
Male nephrologist's sex	3.0 (0.0–4.9)	0.17
Age	2.8 (0.5–0.9)	0.02
Workplace (public clinic in public hospitals)	1.5 (0.0–0.0)	0.44
Previous service (5–15 years)	2.0 (0.1–2.0)	0.17

Correlation is significant at the 0.05 level (two-tailed)

Finally, logistic regression, by dichotomizing nurses into active and inactive according to IPAQ, showed that female nurse's sex (OR 5.1, 95% 0.0–0.0, $p = 0.006$), age (OR 4.2, 95% 0.7–0.9, $p < 0.001$), and working in a private clinic (OR 2.9, 95% 0.0–0.0, $p = 0.04$) were positively and independently associated with active nurses' status (Table 11). For nephrologists, we showed a positive association only between age and inactivity (OR 2.8, 95% 0.5–0.9, $p = 0.02$) (Table 12).

Discussion

The aim of the present study was to examine the attitudes of ESRD patients towards every day physical activity and participation in exercise training, as well as medical and nursing staff's attitude towards renal rehabilitation programs. A negative attitude toward the physical activity from the patients was found, whereas support from their dialysis facility was reported to be weak and insufficient in improving their interest in participating in exercise program.

The most common barrier for the patients was by far fatigue on dialysis and non-dialysis days. According to Ossareh et al. [31] and Sakkas and Karatzaferi [32], fatigue is a common complaint among HD patients and can affect long-term quality of life. Similarly, Fiaccadori et al. [8], Jhamb et al. [12], and Majchrzak et al. [33] demonstrated that fatigue on dialysis days is the most serious obstacle that prevents patients from exercising. In addition, comorbidities, such as diabetes and hypertension, and symptoms like pain and cramps, the fear of accident, the feeling of disability, and aging are identified as the main reasons for negative feelings towards exercise. The lack of time, the reduced willingness to exercise, and the family and medical staff's concern, ranged at lower rates and according to other researchers, are key deterrents in the exercise of ESRD patients [13, 33–36].

Regarding the attitudes of medical staff towards ESRD patient's physical activity, our results showed that physicians and nurses believe that physical inactivity is a major risk factor for both ESRD patients' and general population's health. Although the majority of medical staff stated that most of hemodialysis patients would increase their physical activity levels if they were advised to do so, only 40.0% of the physicians and 62.5% of dialysis nurses had time for counseling. This finding contradicts the fact that 90.0% of physicians and 77.8% of nurses stated that it is their role to inform and advise patients to exercise. The result is that patients are not interested in exercising and rarely ask for relative information.

Moreover, nurse's and nephrologist's negative attitudes showed a significant association with patient's inactivity. Perceptions like "I do not believe that hemodialysis patients are interested in the subject of physical activity" and "I have not time to talk to patients about physical activity" are common negative opinions that are significantly associated with patient's inactivity. Regolisti et al. [36] agree with these findings, as their important finding was that health personnel's negative attitudes were negatively associated with patient's self-reported physical activity.

Similarly, Johansen et al. [37]seem to agree with these findings, as only 38% of participants provided counseling and 5.8% provided some printed information material, and Jhamb et al. [12] noted that the medical staffs were partly encouraging patients to exercise but had no time for giving information and lacked resources for the necessary equipment for patients to exercise in their dialysis unit.

The previous studies appear to be in line with the results of the present study. More specifically, Fiaccadori et al. [8] showed that medical staff maintained a positive attitude towards patients' exercise, as 60% of physicians and 84% of nurses frequently informed and encouraged patients with ESRD to increase their physical activity levels.

In addition, Lenize et al. [11] showed that health personnel had a positive attitude towards general and therapeutic exercise, especially when performed during or after hemodialysis, while Young et al. [13] reported that exercise during dialysis is a burden both for physicians and their patients.

Our results showed that only one of the units participating in the study, the University Dialysis Unit of Thessaloniki, has been providing an interventional exercise program for about 20 years, performed on dialysis days, the first hours of each session, using a bicycle ergometer. The majority of medical and nursing staff did not have any informative videos or brochures about routine exercise for hemodialysis patients, whereas referral to a qualified practitioner was not so frequent. This may be an explanation the reason that, so few HD patients participated in the freely provided exercise program during their dialysis session.

Concerning the experience of the medical staff, previous studies [8, 11] have shown that nephrologists with little experience encouraged and prescribed exercise more often. On the other hand, Johansen et al. [7] showed that the exercise was mainly prescribed by staff with many years of experience. Findings of the present study revealed that there was not even one nephrologist that could prescribe exercise. However, this may be a limitation to our study, as the prescription of interventional exercise, as a form of alternative therapy, is under consideration for our country.

On the contrary, Lenize et al. [11] found very high levels of information and promotion of exercise by health professionals working in dialysis units, with only 8.7% of them not encouraging, guiding, and providing information materials for patients. Similarly, Regolisti et al. [36] noted that positive medical staff attitude is associated with 30.0% increase of physical activity level of HD patients, according to Human Activity Profile (HAP) and Adjusted Activity Score (ASS), compared to medical staff with the lowest interest in physical activity.

Interestingly, binary logistic regression between patient's demographic data and their physical inactivity status according to IPAQ showed that male gender, age older than 70 years, arteriovenous fistula or graft dialysis access, living in a residential area, HD vintage, employment status, CCI, and unparticipating in an interventional exercise program during dialysis session are significantly associated with patient's inactivity. In the literature, the results are partly controversial. More specifically, Tentori [1] and Anderton et al. [38] demonstrated that abstention from exercise and the very old age of ESRD patients were strongly positive correlated variables, resulting in older patients being more distant from exercise, but Fiaccadori [8] and Young et al. [13] disagreed with these findings, while Tentori [1] and Rosa et al. [35] showed that male gender, low BMI, and higher education are positively related to regular moderate-to-high physical activity.

Regarding the association between the CCI and inactivity of patients, our results showed that the increased number of comorbidities expressed by a high CCI mainly is negatively associated with HD patient's activity status. Nevertheless, Tentori [1] and Rosa et al. [35] agree with this result, noting that age and many comorbidities such as coronary heart disease, congestive heart failure, cerebral vascular disease, lung disease, and smoking reduce the level of physical activity of CKD patients.

In the present study, patient's inactivity status and lower educational level of ESRD patients were positively associated. The previous researchers emphasized also that the lower the educational level of ESRD patients is, the less they desire to exercise. We also found a positive correlation between the inactivity status and patient's HD vintage. Similarly, Fiaccadori [8] and Young et al. [13] reported in their individual studies that the duration of chronic kidney disease [CKD] played a pivotal role in a patient's desire to exercise regularly, as the worsening of renal function is accompanied by more health-related problems that discourage the patient from putting exercise into his everyday life.

Furthermore, the previous studies are consistent that there is no correlation between the abstention from exercise and history of transplantation. These reports are not in an agreement with our findings that the previous transplantation could affect the patients' desire for exercise, leading them to abstain from it.

Logistic regression, by dichotomizing patients into active and inactive, has also revealed that there is positive association between fatigue on dialysis and non-dialysis days, and

negative association between having no place to exercise, no exercise partner, pain on dialysis and non-dialysis days, lack of time on dialysis and non-dialysis days, unwillingness for exercise, feeling too old, shortness of breath, fear of getting hurt, sadness, feeling of helplessness, inability to travel, and high burden of medical problems. Fiaccadori et al. [8] disagree that comorbidities and abstention from exercise are positively correlated and agree that there is no correlation between chest pain and abstention from exercise. In contrary, Regolisti et al. [36] noted that fatigue and pain on dialysis days, feeling of helplessness, lack of motivation, and too many medical problems were considered to be major barriers to patient's physical activity status.

Moreover, our statistical analysis revealed that there is negative association between family's and physician's concern for relative dangers and inactivity of patients. Fiaccadori [8] and Tentori et al. [1] agree that lack of incentives and increased perceived patients' risk by health professionals; have been identified as factors that contribute to physical inactivity among patients undergoing hemodialysis.

Finally, in terms of possible correlations of physical activity intensity (according to the IPAQ questionnaire), with sex and age of nephrologists and nurses, the results of this investigation showed that, for nurses, there is a positive association between female sex, age, and workplace and their total high intensity of physical activity, and positive association between nephrologist's age and their low intensity of physical activity. To our knowledge, no relevant study addressing this issue has yet been published.

Limitations of the study

Although many studies in recent years have used the long or the short version of IPAQ, the major limitation of this study may be that we used the IPAQ short version instead of other physical activity questionnaires, such as the Human Activity Profile-Adjusted Activity Score (HAP-AAS), that it has been used more frequently in the hemodialysis population.

Conclusions

In conclusion, patients with ESRD undergoing hemodialysis therapy are faced with a multitude of barriers that suppress their active lifestyle and regular participation in physical activity. Medical and nursing staffs appear to play an important role on the participation of ESRD patients in physical activity and in adoption of a healthy lifestyle with regular exercise. The main finding of this study was that patients' attitudes towards physical activity are mostly based on their socio-economic level and negative medical and nursing staff attitudes towards their physical activity level. Those negative perceptions are strongly associated with patient's inactivity status. Therefore, it could be recommended that medical and nursing staff should spend more time and put more effort in informing and counseling the patients towards increased physical activity and exercise. Target groups for pro-exercise campaigns should include both patients and health personnel, since the latter seem to hold a pivotal and decisive role in the patients' physical activity.

Compliance with ethical standards

Conflict of interest The authors of the present research study declare that there is no conflict of interest regarding the publication of the present article.

References

1. Tentori F et al (2010) Physical exercise among participants in the Dialysis Outcomes and Practice Patterns Study (DOPPS): correlates and associated outcomes. Nephrol Dial Transplant 25:3050–3062
2. Kouidi E (2001) Central and peripheral adaptation to physical training in patients with end-stage renal disease. Sports Med 31(9):651–665
3. Dungey M et al (2015) The impact of exercising during hemodialysis on blood pressure, markers of cardiac injury and systemic inflammation—preliminary results of a pilot study. Kidney Blood Press 40:593–604
4. Simo V et al (2015) Benefits of low intensity exercise programme during hemodialysis sessions in elderly patients. Nefrologia 35(4):385–394
5. Dziubek W et al (2015) The effects of aquatic exercises on physical fitness and muscle function in dialysis patients. Bio Med Res Int. https://doi.org/10.1155/2015/912980
6. Sakkas GK et al (2008) Intradialytic aerobic exercise training ameliorates symptoms of restless legs syndrome and improves functional capacity in patients on hemodialysis: a pilot study. ASAIO J 54(2):185–190
7. Johansen K et al (2003) Exercise counseling practices among nephrologists caring for patients on dialysis. Am J Kidney Dis 41:171–178
8. Fiaccadori E et al (2014) Barriers to physical activity in chronic hemodialysis patients: a single-center pilot study in an Italian dialysis facility. Kidney Blood Press Res 39:169–175
9. Delgado S, Johansen K (2010) Deficient counseling on physical activity among nephrologists. Nephron Clin Pract 116:330–336
10. Capitanini A et al (2014) Dialysis exercise team: the way to sustain exercise programs in hemodialysis patients. Kidney Blood Press Res 39:129–133
11. Lenize C, Marinho P (2015) Knowledge among nephrologists about the importance of exercise in the intradialytic period. J Phys Ther Sci 27:2991–2994
12. Jhamb M et al (2016) Knowledge, barriers and facilitators of exercise in dialysis patients: a qualitative study of patients, staff and nephrologists. BMC Nephrol. https://doi.org/10.1186/s12882-016-0399-z
13. Young H et al (2015) Patient and Staff Perceptions of Intradialytic Exercise before and after Implementation: a qualitative study. PLoS One 10(6):e0128995
14. Delgado C, Johansen KL (2012) Barriers to exercise participation among dialysis patients. Nephrol Dial Transpl 27:1152–1157

15. White Y, Grenyer B (2006) Do we encourage health or illness? A survey of exercise rehabilitation practices for patients in Australian renal units. Renal Soc Aust J 2(1):5–15
16. Morishita Y et al (2014) Primary care physicians' own exercise habits influence exercise counseling for patients with chronic kidney disease: a cross-sectional study. BMC Nephrol. https://doi.org/10.1186/1471-2369-15-48
17. Papathanasiou G et al (2009) Reliability measures of the short International Physical Activity Questionnaire (IPAQ) in Greek young adults. Hellenic J Cardiol 50:283–294
18. Araújo Filho GS et al (2016) Physical activity level of patients on hemodialysis: a cross-sectional study. SciELO 23(3):234–240. https://doi.org/10.1590/1809-2950/14160723032016
19. Costa Rosa CS et al (2015) Assessment of physical activity by accelerometer and IPAQ-short version in patients with chronic kidney disease undergoing hemodialysis. Blood Purif 40:250–255. https://doi.org/10.1159/000437040
20. Wong TS et al (2015) Ratio of dietary n-6/n-3 polyunsaturated fatty acids independently related to muscle mass decline in hemodialysis patients. PLoS One 10(10):e0140402. https://doi.org/10.1371/journal.pone.0140402
21. Hayhurst WSG, Ahmed A (2015) Assessment of physical activity in patients with chronic kidney disease and renal replacement therapy. Springer Plus 4:536. https://doi.org/10.1186/s40064-015-1338-3
22. Demircioglu DT (2018) The association of vitamin D levels and the frailty phenotype among non-geriatric dialysis patients: a cross-sectional study. CLINICS 73:e116. https://doi.org/10.6061/clinics/2018/e116
23. Amaral-Figueroa MI (2014) Physical activity in end-stage renal disease patients: a pilot project in Puerto Rico. PRHSJ 33(2):74–79
24. Grzegorzewska AE (2016) Self-reported physical activity, quality of life, and psychological status in relation to plasma 25-hydroxyvitamin D concentration in patients treated with hemodialysis. Kidney Blood Press Res 41:886–900. https://doi.org/10.1159/000452585
25. Haghighat N et al (2018) Effect of synbiotic and probiotic supplementation on serum levels of endothelial cell adhesion molecules in hemodialysis patients: a randomized control study. Probiot Antimicrob Proteins. https://doi.org/10.1007/s12602-018-9477-9
26. IPAQ. https://sites.google.com/site/theipaq/home
27. Lee P et al (2011) Validity of the International Physical Activity Questionnaire short form (IPAQ-SF): a systematic review. Int J Behav Nutr Phys Activ. https://doi.org/10.1186/1479-5868-8-115
28. Tomioka K et al (2011) Reliability and validity of the international physical Activity Questionnaire (IPAQ) in elderly adults: the Fujiwara-kyo study. J Epidemiol 21(6):459–465
29. Quan H et al (2011) Updating and validating the Charlson Comorbidity Index and score for risk adjustment in hospital discharge abstracts using data from 6 countries. Am J Epidemiol 173(6):676–682. https://doi.org/10.1093/aje/kwq433
30. Radovanovic D (2014) Validity of Charlson Comorbidity Index in patients hospitalized with acute coronary syndrome. Insights from the nationwide AMIS Plus registry 2002–2012. Heart 100(4):288–294. https://doi.org/10.1136/heartjnl-2013-304588
31. Ossareh S et al (2003) Fatigue in chronic peritoneal dialysis patients. Int Urol Nephrol 35(4):535–541
32. Sakkas GK, Karatzaferi C (2012) Hemodialysis fatigue: just "simple" fatigue or a syndrome on its own right? Front Physiol 3:306. https://doi.org/10.3389/fphys.2012.00306
33. Majchrzak K et al (2005) Physical activity patterns in chronic hemodialysis patients: comparison of dialysis and nondialysis days. J Renal Nutr 15(2):217–224
34. Sieverdes J et al (2015) Attitudes and perceptions of patients on the kidney transplant waiting list toward mobile health—delivered physical activity programs. Prog Transplant 25(1):26–34
35. Rosa C et al (2015) Factors associated with leisure-time physical activity among patients undergoing hemodialysis. BMC Nephrol 16:192
36. Regolisti G et al (2018) Interaction of healthcare staff's attitude with barriers to physical activity in hemodialysis patients: a quantitative assessment. PLoS One 13(4):e0196313. https://doi.org/10.1371/journal.pone.0196313
37. Johansen K et al (2000) Physical activity levels in patients on hemodialysis and healthy sedentary controls. Kidney Int 57:2564–2570
38. Anderton N et al (2015) Sedentary behavior in individuals with diabetic chronic kidney disease and maintenance hemodialysis. J Ren Nutr 25(4):364–370