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ENERGY EXPENDITURE AND PHYSICAL ACTIVITY IN END-STAGE RENAL DISEASE: CROSS-SECTIONAL AND LONGITUDINAL OBSERVATIONS

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Background

Physical inactivity in dialysis patients is associated with increased mortality and may have a negative association with body composition (BC), muscle strength and quality of life (QOL). It is uncertain whether physical activity (PA) is affected by the start of dialysis treatment, or an inherent characteristic of end-stage renal disease (ESRD).

Objective

This study firstly aimed to compare PA and energy expenditure (EE) between healthy controls, incident and prevalent dialysis patients, secondly to assess the effect of starting dialysis on PA and EE and thirdly, to study the association between PA, BC, muscle strength and QOL domains in ESRD patients.

Patients and Methods

This study consisted of a cross-sectional part and a longitudinal part. For patient characteristics see table 1. All participants wore a SenseWearTM pro 3 armband (fig. 1a) to measure different PA parameters (total energy expenditure (TEE), activity related energy expenditure (AEE), number of steps and Metabolic Equivalent Task (MET)) for 24 hours on a non-dialysis day. BC was determined by the Body Composition Monitor (fig.1b) (BCM®, Fresenius Medical Care, Bad Homburg, Germany), handgrip strength (HGS) was determined by a hand held dynamometer (fig. 1c) and a four-meter walking test was conducted to determine walking speed (km/h). Lastly, Short Form-36 (SF-36) questionnaires were filled out to measure physical component summary (PCS) scores for the physical domains of QOL.

For the longitudinal part changes in PA and BC parameters, HGS, walking speed and PCS scores were measured in 30 incident patients before the start of renal replacement therapy (RRT) (within one month before start) and five to six months after starting RRT by the same methods as for the cross-sectional part.

Statistical Analysis

- Independent samples t-test
- Repeated measures ANOVA
- Bivariate correlations

Table 1. Patient Characteristics

	Incident Patients	Prevalent Patients	Healthy Controls
Number of Patients	30	29	18
Male (%)	70.0	69.0	61.1
HD/PD	14/16	21/8	-
Age (years)	60.50±13.14	58.17±14.65	61.44±13.47
Height (cm)	172.83±9.85	171.59±9.57	173.44±11.23
Weight (kg)	77.92±18.37	82.75±15.31	75.70±16.27
BMI (kg/m²)	25.74±4.05	28.06±4.45	24.89±3.54
SBP (mmHg)	147.57±21.69	152.07±26.36	139.78±15.07
DBP (mmHg)	83.39±12.60	81.41±12.56	83.38±9.24

HD= Hemodialysis; PD = Peritoneal Dialysis; BMI = Body Mass Index; SBP = Systolic Blood Pressure; DBP = Diastolic Blood Pressure

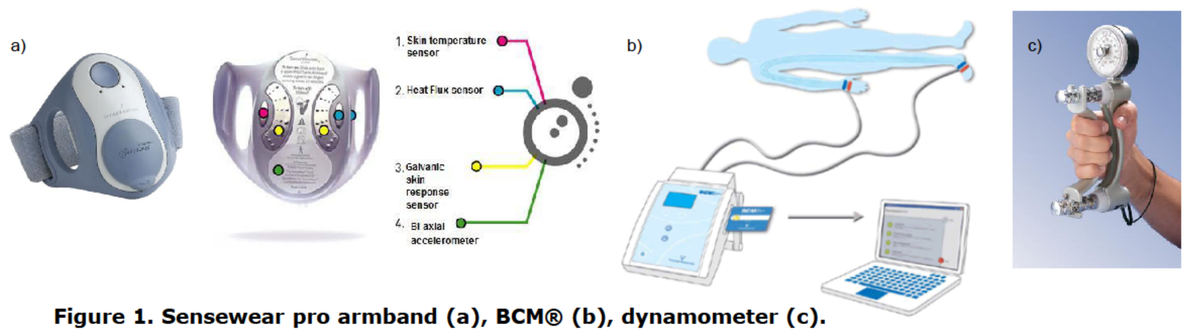

Figure 1. Sensewear pro armband (a), BCM® (b), dynamometer (c).

Results

For the cross-sectional part: EE and PA parameters were significantly lower in incident dialysis patients when compared with healthy controls, but not when compared with prevalent dialysis patients (table 2). No differences in PA parameters were found between HD and PD patients. Lean tissue index (LTI) (kg/m²) tended to be higher in incident patients as compared with prevalent patients, but no significant differences were found between incident patients and healthy controls (table 3). Fat tissue index (FTI) (kg/m²) was significantly higher in prevalent patients when compered with both incident patients as well as with healthy controls (table 3). HGS was not significantly different between incident and prevalent patients as well as for healthy controls (table 2).

For the longitudinal part: no changes over time in the first six months after starting RRT were found for PA and BC parameters as well as for HGS, walking speed and PCS scores in the incident group. Also no differences were found between HD and PD. Furthermore, in the whole patient group (incident and prevalent patients) associations were found between LTI and PA parameters (figure 2), and between FTI and number of steps (R=-0.440; P=0.001) and MET's (R=-0.446; P<0.001). Also associations were found for PCS scores and TEE (R=0.260; P<0.05), AEE (R=0.325; P=0.012), number of steps (R=0.367; P=0.004), and MET's (R=0.352; P=0.006).

Table 2. Energy expenditure, physical activity and functional performance parameters.

Parameter	Incident Patients	Prevalent Patients	Healthy Controls	P-value
TEE (kcal/day)	2182.83±398.42	2369.34±619.91	2617.33±576.48	0.003* / NS† / NS#
AEE (kcal/day)	203.50±264.67	393.24±547.98	739.72±366.62	<0.001* / NS† /0.022#
Steps (number/day)	5164.33±2377.81	4655.86±3535.89	11.568±4619.75	<0.001* / NS† / <0.001#
MET's	1.21±0.23	1.23±0.31	1.46±0.18	<0.001* / NS† / 0.006#
HGS (kg)	28.57±9.22	27.21±12.23	30.44±10.27	NS* / NS† / NS#
Walking Speed (km/h)	5.17±1.45	5.64±1.90	6.28±0.87	<0.01*/ NS† / NS#

† P-value for incident patients vs prevalent patients
* P-value for incident patients vs healthy controls
# P-value for prevalent patients vs healthy controls

TEE = Total Energy Expenditure; AEE = Active Energy Expenditure; MET = Metabolic Equivalent Task; HGS = Handgrip Strength

Table 3. Body composition parameters.

Parameter	Incident Patients	Prevalent Patients	Healthy Controls	P-value
FO (L)	1.30±1.81	1.32±1.65	0.07±0.86	0.01* / NS† / 0.005#
LTM (kg)	42.76±9.25	37.78±11.15	43.58±9.39	NS* / NS† / NS#
ATM (kg)	33.23±13.65	42.96±14.84	31.57±10.13	NS* / <0.05† / 0.007#
LTI (kg/m²)	14.22±2.49	12.75±3.24	14.31±1.72	NS* / *0.06*† / *0.07*#
FTI (kg/m²)	10.88±3.88	14.71±5.14	10.40±3.01	NS* / < 0.01† / 0.002#

† P-value for incident patients vs prevalent patients
* P-value for incident patients vs healthy controls
# P-value for prevalent patients vs healthy controls

FO = Fluid Overload; LTM = Lean Tissue Mass; ATM = Adipose Tissue Mass; LTI = Lean Tissue Index; FTI = Fat Tissue Index

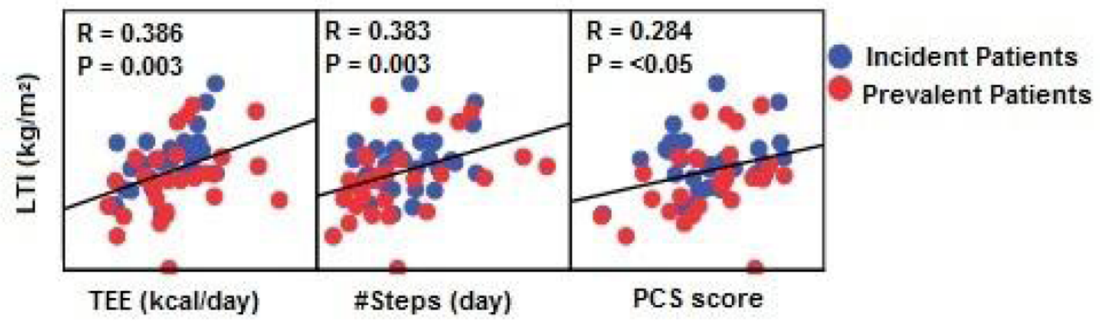

Figure 2. Associations LTI (kg/m²) and TEE, number of steps and PCS scores.

Conclusion

EE and PA parameters are already decreased in the (late) pre-dialysis phase, consistent with a sedentary lifestyle, despite the fact that LTI was not reduced as compared with healthy controls . In prevalent patients PA is reduced, concomitant with a significantly higher FTI. PA on non-dialysis days was not significantly affected by the start of dialysis. PA was positively associated with LTI and QOL. PA already declines in earlier stages of renal failure. Determinants of this decline need to be elucidated in future studies. Therefore, future research in CKD 1-4 is necessary to unravel the pathways involved in changes in PA.

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