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ORIGINAL ARTICLE *Physical activity*

Haemophilia & Exercise Project (HEP): subjective and objective physical performance in adult haemophilia patients – results of a cross-sectional study

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Summary. Recurrent musculoskeletal haemorrhages in people with haemophilia (PWH) lead to restrictions in the locomotor system and consequently in physical performance. Patients' perceptions of their health status have gained an important role in the last few years. The assessment of subjective physical performance in PWH is a new approach. This study aimed to compare the subjective physical performance of PWH with healthy controls and to correlate the results with objective data. Subjective physical performance was assessed via the new questionnaire HEP-Test-Q, which consists of 25 items pertaining to four subscales 'mobility', 'strength & coordination', 'endurance' and 'body perception'. HEP-Test-Q subscales were compared with objective data in terms of range of motion, one-leg-stand and 12-minute walk test. Forty-eight patients (44 ± 11 years) with haemophilia A (43 severe, three moderate) or B (two severe) and 43 controls without haemophilia (42 ± 11 years) were enrolled. PWH showed an impaired subjective physical performance in all HEP-Test-Q subscales and in the total score (52 ± 20) compared with controls (77 ± 10; $P \leq 0.001$). Correlation analyses for the total score of the HEP-Test-Q and objective data revealed values ranging from $r = 0.403$ (one-leg-stand) to $r = 0.757$ (12-minute walk test) ($P \leq 0.001$). PWH evaluated their physical performance poorer in comparison with healthy people. As self-assessment did not always correlate highly with objective data, objective examinations of physical performance in PWH should be complemented with subjective perceptions.

Keywords: coordination, endurance, haemophilia, mobility, physical activity, self-assessment, strength

Introduction

Arthropathy is a common complication in people with haemophilia (PWH) [1] leading to pain and disability. As a precaution against bleeding, PWH often reduce their physical activities and often adopt a sedentary attitude such as in the 1970s when sport was not recommended due to the risk of injuries [2]. This can lead to restrictions of the following motor skills mobility [3,4], strength [5–11], coordination [6,8, 12–14] and endurance [15,16]. Speed has not been considered up to now when examining PWH due to the danger of injury that exceeds the diagnostic and therapeutic value.

In the above mentioned studies, physical performance was evaluated by means of objective examination instruments. However, the self-evaluation of patients' health condition has gained an important role in the past years [17–19]. The HEP-Test-Q, a questionnaire for the assessment of the subjective physical performance was previously developed and validated with good to excellent psychometric characteristics [20].

The present study addresses two research questions: first, do PWH evaluate their subjective physical performance differently from an age-matched control group without haemophilia? Secondly, how does the self-assessment of physical performance correlate with objective data? We hypothesized a decreased subjective physical performance in PWH compared with controls and moderate-to-high associations between subjective and objective parameters.

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The current work is part of the big German sports therapy project 'Haemophilia & Exercise Project' (HEP) (http://www.haemophilia-exercise.de).

Materials and methods

Study design and subjects

Patients were recruited and informed about the HEP by their physicians or in terms of flyers and regional presentations. Forty-eight patients with severe or moderate haemophilia A or B from all over Germany participated in the HEP.

Forty-three control patients without haemophilia or other bleeding disorders were recruited in Thuringia and Saxony (Germany) via announcement posted in public institutions. They were comparable to PWH regarding gender and age. In addition, their physical activity was evaluated via a question concerning the frequency of physical activity per week to ensure that physically they were not more active than the patients.

The project met the standards of the Human Research Ethics Committee, and written informed consent was provided by all participants.

Measurements

Socio-demographical and clinical data. Patients were asked about their socio-demographical (marital status, children, habitation, educational level, employment status) and clinical data (type of haemophilia, severity, bleeding events, treatment modalities, inhibitor, viral infections). Body mass index (BMI) was assessed via the TANITA™-weight scale (TBF-531). The joint status was examined using the Orthopaedic Joint Score (OJS) [21], which is composed of the clinical score (e.g. swelling, muscle atrophy, crepitation), the pain score and the bleeding score. All three scores can be summed up to a total score with a maximum of 100 score points indicating high impairments in the orthopaedic status.

Activity level. Participants were asked about their current physical activities that had to be answered on a five-point Likert scale from 0 ('not active') to 4 ('active more than three times/week').

Objective physical performance. Range of motion. As part of OJS, mobility was measured in knees, ankles and elbows using a goniometer [21].

One-leg-stand. The one-leg-stand is an extensive test assessing coordination and strength-endurance [6,22,23]. The test was conducted barefoot for the left and right leg on even ground with open eyes. Holding position time with a maximum of 30 s was documented. The mean was calculated out of the three attempts possible for each patient. Ten PWH did not carry out the one-leg-stand because of acute bleeding events or the inability to stand on one leg due to pes equines or contractures in knees.

12-minute walk test. Endurance was measured using the 12-minute walk test on cinder track [24] concerning heart rate before and at the end of the test, walking distance, as well as perceived exertion using the Likert scale (6–20) devised by Borg [25] and the severity of pain rather than grade using a visual analogue scale (VAS) (0–10) [26]. Eight patients missed the walking test due to illness, whereby 26 control patients could not attend the walking test because of missing cinder track at location or bad weather conditions.

Subjective physical performance. HEP-Test-Q. Subjective physical performance was evaluated using the HEP-Test-Q questionnaire consisting of 25 items pertaining to four dimensions 'mobility', 'strength & coordination', 'endurance' and 'body perception' as well as one single item, which assesses changes in physical activity compared with last year [20]. Answer categories range from 1 ('never') to 5 ('always') on a 5-point Likert scale. In addition, dimensions can be summarized to a total score. Values are transformed to a 0–100 scale with higher scores representing better physical performance. One control patient did not fill out the HEP-Test-Q, and one haemophilia patient forgot to answer the 'mobility'-scale.

Statistical analyses

All statistical analyses were conducted using the SPSS programme version 17.0 (SPSS Inc., Chicago, IL, USA). Data are shown as frequency distribution in percentage or as mean (M) ± standard deviation (SD) and range (min–max). All data were tested for normal distribution using Kolmogorov–Smirnov test. Chi-squared test was used to compare socio-demographical data between patients and controls. For the comparison of clinical and physical data, unpaired Student's *t*-test or Mann–Whitney *U* test was utilized. Correlations were determined by means of the Spearman coefficients. $P \leq 0.05$ was defined as significant.

Results

Socio-demographical and clinical data

The mean age of PWH ($n = 48$) was 44 ± 11 years. Forty six patients had haemophilia A (96%), of whom 43 were severely affected and two had severe haemophilia B (4%). PWH reported on average 6.4 ± 7.0 (range 0–24) bleeds in the previous 12 months and 25.1% had target joints. 54.2% of patients were on prophylaxis. 8.3% had inhibitors, 68.8% suffered from chronic hepatitis C and 22.9% from HIV infection.

Table 1. Clinical data and activity level; people with haemophilia (PWH) vs. controls.

	PWH (n = 48)	Controls (n = 43)	
	M ± SD (min–max)	M ± SD (min–max)	P-value
Age (years)	44 ± 11 (19–65)	42 ± 11 (20–63)	n.s.[†]
BMI (kg m^{-2})	25.3 ± 4.7 (18.3–38.6)	26.7 ± 3.3 (17.6–33.0)	0.031
OJS total score (0–100)	29.1 ± 9.8 (8.0–48.0)	3.6 ± 2.3 (0.0–10.0)	≤0.001
Activity level (times/week)*	1.3 ± 1.3 (0.0–4.0)	0.7 ± 0.9 (0.0–3.0)	0.026

n.s., not significant;
*Answer categories 0 = not active, 1 = active once/week, 2 = active twice/week, 3 = active three times/week, 4 = active more than 3 times/week;
[†]Student's t-test, the others with Mann–Whitney U test

The mean age of controls (n = 43) was 42 ± 11 years. Controls showed a much better OJS compared with PWH and reported no viral infections. PWH had a lower BMI and were physically more active than controls (see Table 1). The major part of the study population was married, and one-third had a university degree. The only difference found between both groups was related to their employment status (see Table 2).

Objective physical performance

In comparison with control patients, PWH showed restrictions in almost all motor skills. Two haemophilic patients had to stop the 12-minute walk test earlier because of low back pain or troubles in the knee; no significant differences were found in terms of heart rate and Borg scale (see Table 3).

Table 2. Socio-demographical data; people with haemophilia (PWH) vs. controls.

		PWH (n = 48)	Controls (n = 43)	
		N (%)	N (%)	P-value
Marital status	Single	15 (31.3)	17 (39.6)	n.s.
	Married	29 (60.4)	25 (58.1)	
	Divorced	3 (6.3)	0 (0.0)	
	Widowed	1 (2.1)	0 (0.0)	
	Data not available	0 (0.0)	1 (2.3)	
Number of children	0	20 (41.7)	14 (32.6)	n.s.
	1	13 (27.1)	9 (20.9)	
	2	13 (27.1)	15 (34.9)	
	3	2 (4.2)	3 (7.0)	
Habitation	<5.000 inhabitants	21 (43.8)	9 (20.9)	n.s.
	5.000–50.000	15 (31.3)	19 (44.2)	
	50.000–100.000	3 (6.3)	3 (7.0)	
	>100.000	9 (18.8)	12 (27.9)	
Education	Elementary school	12 (25.0)	4 (9.3)	n.s.
	Secondary school	7 (14.6)	12 (27.9)	
	University qualification	2 (4.2)	5 (11.6)	
	Apprenticeship	5 (10.4)	6 (14.0)	
	University	20 (31.7)	15 (34.9)	
	Data not available	1 (2.1)	1 (2.3)	
Employment	Trainee	0 (0.0)	6 (14.0)	≤0.001
	Employed	28 (58.3)	19 (44.2)	
	Self-employed	2 (4.2)	11 (25.6)	
	Pensioner	16 (33.3)	1 (2.3)	
	Unemployed	0 (0.0)	1 (2.3)	
	Incapable to work	2 (4.2)	0 (0.0)	
	Data not available	0 (0.0)	5 (11.6)	

n.s., not significant

Subjective physical performance

Concerning the subjective assessment of their physical functioning, PWH reported the highest impairments in the domains 'strength & coordination' (49.3 ± 24.7) and 'endurance' (49.4 ± 20.4) of the HEP-Test-Q (see Fig. 1). Compared with healthy controls, PWH showed a significantly worse subjective physical performance in all domains.

Inter-correlation between subjective and objective physical performance

Analyses revealed acceptable to high correlations between subjective physical performance in terms of HEP-Test-Q and objective physical performance in terms of range of motion, one-leg-stand and 12-minute walk test. Correlation coefficients ranged from r = 0.403 (one-leg-stand) to r = 0.757 (12-minute walk test) ($P \leq 0.001$) with the total score of the HEP-Test-Q (see Table 4). No significant correlation was found for one-leg-stand and the dimension 'body perception' of the HEP-Test-Q.

Discussion

This is the first study, which compares the subjective physical performance in PWH with controls without haemophilia using the new questionnaire HEP-Test-Q. To examine whether subjective and objective data are correlated, results of the HEP-Test-Q were compared with objectively measured data.

PWH compared with controls showed differences in socio-demographical and clinical data; the control group had a worse BMI and a lower activity level, but showed a better OJS. Differences in the employment status are caused by the disorder haemophilia [27,28].

PWH were significantly impaired in all motor skills, which were mirrored in subjective perceptions of physical performance. As expected, patients evaluated their physical performance in all subscales poorer in

Table 3. Objective physical performance (motor skills); people with haemophilia (PWH) vs. controls.

		PWH (n = 48)	Controls (n = 43)	
		M ± SD (min–max)	M ± SD (min–max)	P-value
Range of motion (degree)	Knee left	107 ± 39 (19–156)	151 ± 5 (137–160)	≤0.001
	Knee right	101 ± 40 (0–153)	150 ± 6 (133–160)	≤0.001*
	Ankle left	28 ± 16 (0–73)	70 ± 7 (48–89)	≤0.001
	Ankle right	29 ± 13 (4–66)	70 ± 7 (50–89)	≤0.001*
	Elbow left	112 ± 31 (58–161)	150 ± 5 (140–160)	≤0.001
	Elbow right	117 ± 32 (42–160)	150 ± 4 (140–160)	≤0.001
One-leg-stand (s)	Left	21 ± 11 (1–30) (n = 38)	29 ± 4 (12–30)	≤0.001
	Right	21 ± 11 (1–30) (n = 41)	29 ± 2 (15–30)	≤0.001
		PWH (n = 40)	Controls (n = 17)	P-value
12-minute walk test	Pre-heart rate (1 min^{-1})	81 ± 13 (56–112)	79 ± 9 (67–103)	n.s.*
	Post-heart rate (1 min^{-1})	121 ± 22 (77–186)	133 ± 14 (105–156)	n.s.*
	Walking distance (m)	984 ± 301 (170–1603)	1403 ± 100 (1245–1605)	≤0.001*
	Borg scale (6–20)	12 ± 3 (6–17)	11 ± 2 (8–15)	n.s.
	VAS (0–10)	1.8 ± 2.7 (0.0–8.0)	0.4 ± 1.2 (0.0–5.0)	0.023

n.s., not significant; *Student's t test, the others with Mann–Whitney U test

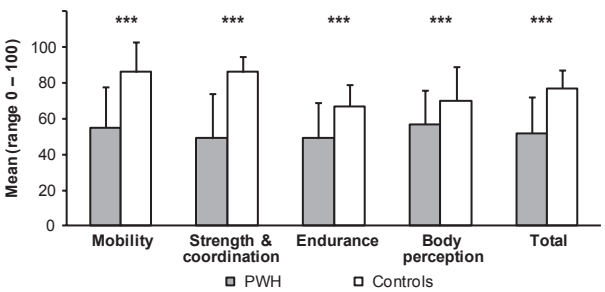

Fig. 1. Subjective physical performance (HEP-Test-Q); people with haemophilia (PWH) (n = 48) vs. controls (n = 42); Mann–Whitney U test, $***P \leq 0.001$.

comparison with healthy people showing the highest impairments in the dimensions 'strength & coordination' and 'endurance'.

The correlation analysis showed that objective parameters did not always correlate with the self-assessment of physical performance. This supports the necessity in the development of patient-reported assessments, and the implementation in clinical research and practice [29].

In the current study, a problem in the recruitment of the control group appeared. We had intended to have a comparable control group for socio-demographical data and physical activity, but the study revealed the difficulty in finding comparable controls in a field study for all aspects; our controls were only comparable for gender and age. The study also revealed that haemophilia patients had worse objective parameters in terms of range of motion, one-leg-stand and the distance covered in the 12-minute walk test as well as a higher perceived pain after the walking test. Moreover, a control group at least comparable in terms of socio-demographical data was desirable.

Another existing questionnaire for the subjective assessment of functional health is the Haemophilia Activities List (HAL) [30]. The HAL assesses, in particular, various activities of daily life (ADL) such as use of transportation, self-care and household tasks of patient comparable to the questionnaire for the assessment of autonomy in daily life [31]. However, these dimensions do not reflect the subjective physical performance related to classical motor skills established in sports science. In contrast, the newly developed HEP-Test-Q [20] covers all these aspects and serves further as the only instrument that assesses body perception (e.g. well-being, exposure of stress, self-esteem), which is

Table 4. Correlation between objective data (range of motion, one-leg-stand, walking distance) and corresponding subscales of the subjective HEP-Test-Q; for both subject groups.

		HEP-Test-Q-scales				
		Mobility	Strength & coordination	Endurance	Body perception	Total
Range of motion	Knee left (n = 89)	0.662***	0.720***	0.619***	0.428***	0.708***
	Knee right (n = 90)	0.615***	0.726***	0.598***	0.409***	0.695***
	Ankle left (n = 89)	0.629***	0.727***	0.476***	0.382***	0.663***
	Ankle right (n = 89)	0.654***	0.735***	0.530***	0.422***	0.700***
	Elbow left (n = 90)	0.504***	0.635***	0.461***	0.337***	0.577***
	Elbow right (n = 90)	0.442***	0.578***	0.446***	0.270**	0.520***
One-leg-stand	Left (n = 80)	0.396***	0.413***	0.358***	$0.178^{n.s.}$	0.403***
	Right (n = 83)	0.370***	0.481***	0.391***	$0.187^{n.s.}$	0.439***
12-minute walk test	Walking distance (n = 56)	0.604***	0.809***	0.635***	0.438***	0.757***

n.s., not significant; $**P \leq 0.01$; $***P \leq 0.001$

considered important for PWH [13,32] and cannot be measured objectively.

The number of studies in the assessment of motor skills in adult PWH is quite low. Compared with literature regarding *mobility*, restrictions in the flexibility of the ischiocrural musculature (*M. biceps femoris, M. semitendinosus, M. semimembranosus*) were presented descriptively [3,4], but comparisons with a control group were lacking. Mihalova [33] did not find significant differences between PWH and healthy controls. All three studies were carried out in children and adolescents.

More studies are present for *strength*. First of all, the quadriceps femoris muscle, which plays an important role in locomotion, was significantly reduced in PWH compared with subjects without haemophilia [4–11,14,15]. In contrast, only a few studies were performed in haemophilic adults including a control group [6,14].

Three important studies proved significant limitations in *coordination* via balance tests in adults with haemophilia [6,13,14]. Other studies revealed equivalent results on a descriptive level, but for younger patients – provided that age was specified [4,8,12,34].

For *endurance*, worse physical performance were demonstrated in PWH, both in children [15,35,36] and adults [16]. Mihalova [33] did not find significant differences between PWH and healthy controls.

Conclusion

The HEP-Test-Q proved to be a practicable questionnaire, which supplemented objective measurements, and is therefore suitable for clinical practice providing an initial indication about the physical performance in PWH. Our results confirmed the important role of combining objective and subjective data in the assessment of physical performance that should be integrated in future studies. Furthermore, our data underline the importance of an appropriate and immediate treatment when joint bleeds occur to avoid haemophilic arthropathy [37] and corroborated the basic necessity of sports-therapeutic treatments as an integral part in haemophilia management. Further analyses of data collected in the framework of the HEP programme will focus on training effects on subjective and objective outcomes.

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