ESTABLISHING NORMATIVE DATA FOR THE SHAP TEST IN SLOVENIA
NORMATIVNI PODATKI ZA SOUTHAMPTONSKI TEST ZA OCENJEVANJE ROKE (SHAP) V SLOVENIJI

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Izvleček

Izhodišče:
Da bi lahko ocenili vpliv poškodbe zgornjega uda in učinek različnih rehabilitacijskih postopkov na funkcioniranje posameznika, so potrebne mere izida z dobrimi psihometričnimi lastnostmi, ki so posebej namenjene ocenjevanju funkcije zgornjih udov in povezanih dejavnosti. Zanje morajo biti na voljo tudi normativni podatki. Namen naše študije je bil zbrati normativne podatke za slovensko populacijo različnih starosti za instrument SHAP (Southamptonski test za ocenjevanje roke).

Metode:
Sto osemdeset zdravih oseb obeh spolov, starih od 15 do 74 let, smo testirali s testom SHAP.

Rezultati:
Ugotovili smo, da pri zdravih osebah funkcija roke upada s starostjo. V vseh starostnih skupinah so imele ženske v povprečju nekoliko boljšo funkcijo roke kot moški. Znatnih razlik med funkcijo dominantne in nedominantne roke ni bilo.

Zaključek:
Zbrani normativni podatki za test SHAP v Sloveniji so podobni kot normativni podatki v Veliki Britaniji.

Ključne besede:
zgornji ud, funkcioniranje, testiranje, rehabilitacija, mere izida

Abstract

Background:
To demonstrate the impact of an upper limb impairment and the effect of different rehabilitation procedures on a person's function, outcome measures with good psychometric properties specific for assessing upper limb function and activity and their normative data are needed. The aim of the present study was to determine the normative data for the Southampton Hand Assessment Procedure (SHAP test) for healthy Slovene population of different ages.

Methods:
One hundred eighty healthy Slovene volunteers 15 to 74 years old were tested with the SHAP test.

Results:
It was found that in healthy subjects, hand function decreases with age. Women of all ages have slightly higher hand function than men of the same age group on average. There was no significant difference between dominant and non-dominant hand function.

Conclusion:
The established normative data for the Southampton Hand Assessment Procedure (SHAP test) in Slovenia are similar to those in the United Kingdom.

Key words:
upper limb, function, testing, rehabilitation, outcome measures

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INTRODUCTION

Upper limbs, and especially hands, are used for most activities of daily living, as well as expression, communication and affection (1, 2). For example, after upper limb amputation there are problems with grasping, lifting, pushing, pulling, writing, and typing (3, 4). There are also potentially problems with driving (5) and carrying objects. Thus, impairment of an upper limb affects all aspects of people's lives. In the terms of the WHO International Classification of Functioning, Disability and Health (ICF) (6) this covers all three domains; body structure and function, activities and participation, but and also quality of their lives.

Upper limb impairments result from many different diseases and injuries. Among the common diseases are rheumatoid arthritis and other rheumatologic diseases, different neurological conditions and diseases such as; stroke, cerebral palsy, multiple sclerosis. Approximately 67% to 94% of patients with rheumatoid arthritis have impairment of the upper limb (7). In stroke patients 75 to 80% have impairment of the upper limb (8, 9) which limits their ability to perform daily activities (10). In US and Scandinavian countries the incidence of upper limb amputation varies from 0.5 up to 18.5 per 100,000 populations (11 – 13).

Rehabilitation of persons with these diseases and injuries includes different techniques to improve their upper limb function and to decrease limitations on their activities and participation. To be able to demonstrate the outcome during the rehabilitation, outcome measures with good psychometric properties specific for assessing upper limb function, activity limitations due to upper limb impairment and their normative data are needed. For the different domains, different tests or questionnaires specific to that domain must be used. There are a wide range of hand function tests (for full review see Wright) (14). When used in clinical practice with patients who have impairments of one side only (stroke, upper limb amputations, and injuries of one hand) it is possible to compare the healthy and impaired hand. In other patient groups, such as patients with spinal cord injury and rheumatoid arthritis, where both hands are impaired, normative data is needed for comparison.

The test used for the longest time is the Jebsen-Taylor hand function test (JTT) (15). Its psychometric properties have been reported by the author (15) and repeated in two studies in 2010 (16, 17). Later studies did not confirm completely the original data. Jebsen (15) included only three types of patients in his tests for discriminant ability (stroke patients, patients with RA and these with tetraparesis due to traumatic spinal cord injury). Sears and Chung (17) found poor discriminant validity in patients after different surgical interventions, included patients with rheumatoid arthritis and does not correlate well with patient-reported outcomes. Alternatively Ferreiro et al confirm it has good inter- and intra-rater reliability if scoring form video tapes in Portuguese stroke patients (16). Ferreiro (16) did not include patients with other diseases, conditions or injuries that may affect upper limb and hand function. Jebsen test has not been validated for prostheses users (18).

At our Institute in the past different test and questionnaires for assessing hand function and any improvement during rehabilitation have been used, such as AHA for CP children (19), OPUS-UEFS and ABILHAND questionnaire, University of New Brunswick (UNB) test and Assessment of Capacity for Myoelectric Control (ACMC) for subjects following upper limb amputation (20 – 22). Hand functions in stroke patients, and patients with spinal cord injury and rheumatoid arthritis at the Institute have not been assessed with any standardised test previously. All of used test are observer subjective, whereas questionnaires are subject subjective. In spite of defined scales, it may still be observer subjective which score will subject get, especially if there is no inter-rater reliability. In questionnaires it is not necessary that what is for one light is light also for the other – so they are subject subjective. In SHAP, the subject measures time and this does not require the observational skills of the tester (23), thus it is neither observer neither subject subjective.

Southampton Hand Assessment Procedure (SHAP test) has been developed by Light et al. (24) for the assessment of the function of prosthetic hands within the context of other hand impairments (25). The basis of the SHAP score is the difference between the time to execution of a series of 26 tasks of a subject and a normative population from the United Kingdom. The nominal value is one hundred and a score of less than 95 is regarded as impaired (24, 25). The smallest real difference (SRD) is a measure of the smallest statistically significant difference (26, 27). Any change larger than the SRD implies a real difference with 95% confidence. For SHAP the SRD was found to be 2.0 (23).

In response to limited time for measurement in the modern clinical setting, SHAP was designed to measure the function of the subject's hands, in a fast and valid manner for a wide range of different conditions and diseases, such as rheumatoid arthritis and different injuries (23, 28). In a broad literature study Wright (14) identified SHAP as having good psychometric properties, but requiring some validation in some areas, preferably by those not directly connected with its development.

Metcalf et al. (29) published normative scores for UK population. An assumption that there are no differences between populations is one that can lead to inaccuracies in measurement. As the SHAP scores depend on a population based in the United Kingdom, it is worth ensuring that its use in other countries that this assumption remains valid. The aim of the present study was to determine the normative data for the Southampton Hand Assessment Procedure (SHAP test) for healthy Slovene population of different ages.

METHODS

Subjects

One hundred eighty healthy volunteers (90 men and 90 women) 16 to 75 years old were tested. They were divided into six age groups (16 – 25, 26 – 35, 36 – 45, 46 – 55, 56 – 65 and 66 – 75 years). The inclusion criteria were:

- Healthy subjects without previous history of upper limb injury or disease which may impair the upper limb;
- No cognitive problems;
- Willing to participate.

The subjects were asked if they are right/left handed or they used both hands equally (ambidextrous).

Testing

Subjects willing to participate were checked if fulfil inclusion criteria. If they do, they were tested immediately. All subjects were tested using the SHAP test administered by the same person and the same equipment. Before measurement, the tester explained to each individually the purpose of the study and the testing procedure. Both hands were tested. The order of the hands was randomised. Sealed envelopes were used to blind the process.

SHAP test uses a form-board and self-timed tasks divided into two parts: Abstract objects and stimulated activities of daily living (ADL) (24). The abstract objects assess six standard grips (Tip, Lateral, Tripod, Spherical, Power, Extension). Objects of two different weights are used (light and heavy). The second part uses fourteen simulated ADLs, which are based on at least one standard grip per task (cutting, pouring, lifting, transferring, loads). All tasks are self-timed to exclude reaction time of assessor (24) as this has been shown to increase the reliability of such test (30). From these times, a computer programme calculated an overall index of functionality and separated indexes for each grip. The nominal score for each index is 100 (normal hand function) and the lowest zero.

The data were statistically analysed using descriptive statistics, Pearson correlation, simple linear regression, independent-samples *t*-test and paired-samples *t*-test. No correction for multiple tests was performed.

RESULTS

Ninety women and 90 men were included into study (Table 1). Among them 165 were right handed, 10 left handed and 5 ambidextrous. Due to small number of left-handed, indexes were calculated for dominant and non-dominant hand and not for left and right-handed. Those who were ambidextrous were excluded.

Table 1: *Characteristics of the included subjects.*

Age group (years)	Men					Women				
	Number				Mena age (SD)	Number				Mean age (SD)
	Right-handed	Left-handed	Ambidex-trous	Total		Right-handed	Left-handed	Ambidex-trous	Total	
16 – 25	14	1		15	20 (3.1)	13	1		14	21 (3.2)
26 – 35	16		1	17	29 (3.5)	16	2		18	29 (3.5)
36 – 45	11	2		13	40 (2.4)	14		1	15	41 (3.5)
46 – 55	19			19	51 (3.0)	12	2	2	16	50 (2.9)
56 – 65	10	2		12	60 (2.5)	11		1	12	58 (2.7)
66 – 75	14			14	70 (2.5)	15			15	70 (2.5)
Total	84	5	1	90	45 (18.9)	81	5	4	90	45 (18.3)

Results for overall index of function and indexes for specific grips for men and women, dominant and non-dominant hand separately are presented in Tables 2 and 3. Women performed statistically significantly better on all grips of both hands, except Tripod and Power on the dominant hand ($p = 0.077$, $p = 0.057$). Figures 1 and 2 present the association between overall grip and age for women and men, respectively. There was also a statistically significant but clinically not important difference between dominant and non-dominant hand in power grip (mean: dominant 96.08, non-dominant 96.58; $p = 0.004$). For overall score and other grips there was no difference between dominant and non-dominant hand.

Table 2: *SHAP test normative data for women in Slovenia (means, standard deviations in parentheses; D – dominant hand, N – non-dominant hand).*

Grip	Overall		Sphere		Tripod		Power		Lateral		Tips		Extension	
Age (years)	D	N	D	N	D	N	D	N	D	N	D	N	D	N
16 - 25	97 (1.22)	98 (1.28)	97 (1.14)	98 (1.34)	97 (0.95)	97 (1.28)	97 (1.05)	97 (1.05)	97 (0.97)	97 (1.16)	97 (1.03)	97 (1.17)	97 (1.22)	97 (1.65)
26 - 35	98 (0.91)	98 (1.18)	97 (1.24)	97 (1.80)	97 (0.97)	97 (1.50)	97 (1.08)	97 (1.84)	97 (0.67)	98 (0.92)	97 (0.71)	97 (0.79)	97 (0.96)	97 (1.28)
36 - 45	98 (1.23)	98 (1.03)	98 (1.00)	98 (1.07)	97 (1.12)	97 (1.17)	97 (1.09)	97 (1.55)	98 (1.16)	97 (1.12)	97 (0.99)	97 (1.02)	97 (1.40)	98 (1.02)
46 - 55	98 (1.64)	98 (1.34)	97 (1.59)	97 (1.73)	97 (1.69)	97 (1.17)	97 (1.45)	97 (1.49)	98 (1.27)	97 (1.45)	97 (1.54)	97 (1.27)	98 (2.10)	97 (1.44)
56 - 65	96 (2.90)	95 (2.87)	96 (3.75)	96 (2.59)	96 (2.37)	95 (3.43)	97 (2.38)	94 (3.44)	96 (2.69)	95 (3.32)	95 (3.47)	95 (4.25)	96 (3.29)	95 (3.32)
66 - 75	97 (0.80)	97 (1.16)	97 (0.91)	97 (1.60)	96 (1.32)	95 (2.31)	97 (1.91)	96 (2.83)	97 (1.53)	97 (2.09)	95 (2.49)	97 (1.41)	97 (2.13)	97 (2.19)

Table 3: *SHAP test normative data for men in Slovenia (means, standard deviations in parentheses; D – dominant hand, N – non-dominant hand).*

Grip	Overall		Sphere		Tripod		Power		Lateral		Pinch		Extension	
Age (years)	D	N	D	N	D	N	D	N	D	N	D	N	D	N
16 - 25	97 (1.58)	97 (1.77)	95 (6.25)	96 (1.70)	96 (2.94)	96 (2.09)	96 (1.86)	96 (1.73)	96 (1.36)	96 (1.52)	96 (1.18)	97 (0.83)	96 (2.23)	96 (1.97)
26 - 35	97 (1.09)	97 (1.01)	97 (1.00)	97 (1.71)	97 (0.75)	97 (1.13)	95 (2.78)	96 (2.50)	96 (0.96)	97 (1.01)	96 (1.25)	96 (0.93)	96 (1.71)	96 (1.48)
36 - 45	98 (0.90)	98 (1.66)	97 (1.66)	97 (2.17)	97 (1.08)	97 (1.50)	97 (1.36)	97 (1.34)	97 (0.73)	97 (1.76)	97 (1.15)	97 (1.99)	97 (1.03)	97 (1.30)
46 - 55	95 (3.42)	96 (3.08)	95 (2.25)	96 (2.15)	95 (4.06)	95 (3.62)	95 (3.36)	96 (2.55)	96 (2.77)	96 (2.64)	95 (3.72)	95 (3.19)	95 (3.29)	95 (2.77)
56 - 65	94 (2.07)	95 (2.22)	96 (1.93)	95 (1.50)	94 (2.10)	95 (2.09)	93 (7.34)	95 (2.11)	95 (2.74)	96 (1.88)	93 (2.39)	94 (2.73)	93 (4.58)	94 (2.81)
66 - 75	95 (6.02)	96 (1.20)	97 (2.57)	97 (1.25)	96 (1.51)	96 (3.10)	97 (1.18)	97 (1.83)	97 (1.73)	97 (1.75)	96 (1.92)	96 (1.74)	97 (1.90)	97 (1.22)

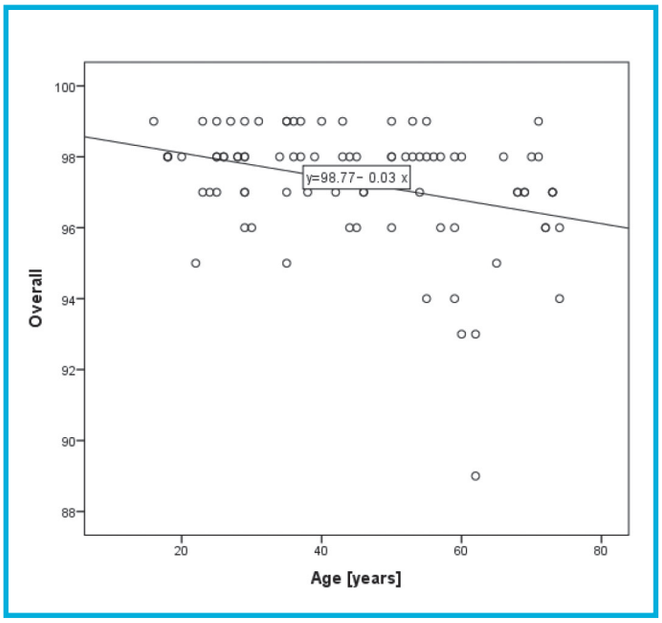

Figure 1: *Relation between overall SHAP index and age for the right hand of the included women (least-squares regression line superimposed; $r^2 = 0.117$).*

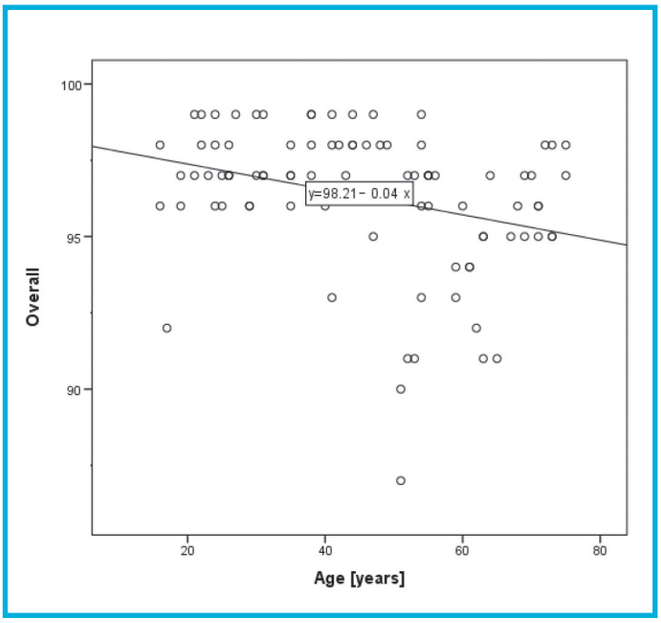

Figure 2: *Relation between overall SHAP index and age for the right hand of the included men (least-squares regression line superimposed; $r^2 = 0.095$).*

DISCUSSION

It was found out that in healthy subjects hand function decreases with age, women of all ages have slightly better hand function than men of the same age group. No differences were found between dominant and non-dominant hand except for power grip, which was slightly better in non-dominant hand. Clinically this difference of 0.5% is not important (the SRD for SHAP is 2; 23). This may be because the non-dominant hand is usually used for fixation, stabilisation of objects, requiring grip strength, while a greater number of fine tasks are performed by dominant hand.

Hand function tends to improve and develop during childhood, is the greatest in early adulthood and starts to decrease with age (29, 31 – 33). Children and teenagers younger than 16 years were not included, as SHAP has not been validated for this population, but subjects in the first age group (16 – 25 years) had slightly lower indices than adults. In this population the scores start to decrease after 45 years of age, which is quite early, but decrease is very small. Similar results were observed also in UK population (34). In all age groups it was attempted to include subjects with very different background and exclude subjects whose profession may influence the results (surgeons or others performing precision activities). So in the youngest age group most of the included subjects were students at different faculties of University of Ljubljana, whereas in the others were included stuff members and outpatients who had no recorded hand problems, they had no disease that may influence hand function or injury of any upper limb.

In accordance with other studies (31, 33) it was found that women had slightly greater hand function score than men. This difference was across age groups and for hand dominance, although the precise values differed. A closer examination of the raw data, the main difference between men and women could be attributed to specific ALDs. The greatest difference was for opening buttons, where women were much quicker than men. Men were quicker at cutting plasticine and turning the key. No difference between men and women was observed in using the screwdriver. It is difficult to simply explain these differences, because none of the tasks is really gender specific. Both men and women have to open buttons, cut food and use keys. To exclude the influence of work and gender specific tasks, it is important include subjects with very different professions.

The dominant hand is generally more skilled than non-dominant. Petersen (34) found out that dominant hand is on average five to ten percent more skilled than non-dominant one. In these test the differences of about two percent is much smaller, it is slightly greater in women than in men. SHAP was designed to be a more general tool measuring overall function, not dexterity, thus not to be sensitive to these personal differences.

In spite that the number of included subjects is almost twice as big as in study of Metcalf (29) and three times as big as in the study of Jebsen (15), the main limitation of the study is the small number of left-handed subjects. As a result it was not possible to measure normative values for right- and left-handed subjects, but only for dominant and non dominant hands. Another limitation of our study is that we did not use any objective test for determining the hand dominance, but relied on self-report. Sophistication of the statistical analyses could also have been improved (e.g., by using analysis of variance instead of multiple *t*-tests, and by fitting robust regression lines because of potential outliers).

CONCLUSION

The established normative data for the Southampton Hand Assessment Procedure (SHAP test) in Slovenia are similar to those in the UK. In healthy Slovene subjects hand function decrease with ages, and women of all ages have slightly better hand function than men of the same age group.

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