Self-reported Functional Status in US Service Members After Combat-Related Amputation

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Abstract: The objective of this study was to describe the functional status of US service members after combat-related amputation. This was a cross-sectional analysis of data from a subsample of the Wounded Warrior Recovery Project, an ongoing, web-based, longitudinal examination of patient-reported outcomes of injured service members. The study sample included 82 Wounded Warrior Recovery Project participants with a combat-related lower extremity amputation who reported using a prosthetic device and completed the Orthotics and Prosthetics Users' Survey Lower Extremity Functional Status, which measures self-reported functional status in participants with a prosthetic device. Basic activities, such as walking indoors, getting on and off the toilet, and getting up from a chair, were reported by the majority of participants as "very easy/easy," whereas higher-level activities, such as climbing stairs, walking long distances, or running, were more often reported as "slightly difficult/very difficult" or "cannot do this activity." Functional status varied significantly by amputation site (unilateral below knee, unilateral above knee, or bilateral; $P = 0.004$), with significantly better function reported in those with unilateral below knee than bilateral amputation ($P < 0.05$). These findings highlight deficits in the functional status of US service members with combat-related amputation. Self-reported functional status of daily activities may help target important activities for patient-centered goals.

Key Words: Amputation, Combat Injury, Functional Status, Lower Extremity

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Extremity injuries composed the largest proportion of injuries in Operations Enduring Freedom and Iraqi Freedom, with estimates ranging between 41% and 54% of all combat injuries.[1,2] The most serious of these injuries are amputations.[3] Service members with amputations experience numerous challenges, yet few studies have explored long-term, functional limitations associated with amputation. Considering this is a relatively young population, patient-reported functional status may have long-term impacts and is crucial to informing clinicians how to best provide patient-centered care.[4]

Research on functional limitations in individuals after combat-related amputation is mostly focused on measures of single skills (e.g., walking speed) or balance and agility testing, rather than self-report of day-to-day activities. Akarsu et al.[5] examined 30 individuals with combat-related amputations (15 unilateral and 15 bilateral) and found the bilateral amputation group scored lower than the unilateral amputation group in physical functioning, as measured by walking speed. In 118 service members with at least 1 lower limb amputation, Gaunaurd et al.[6] found significantly different scores on high-level physical functioning skills, such as single leg stance and balance and agility tests, between unilateral below knee, unilateral above knee, and bilateral groups, with the highest scores in the unilateral below knee group.

Although observed physical functioning, such as walking speed, appears to be sensitive in assessing the differences between amputation levels, patient-reported outcomes of day-to-day activities can provide unique insight into an individual's assessment of personally relevant functioning. The purpose of this brief report was to describe the functional status of US service members after combat-related, lower extremity amputation as assessed by a self-reported measure of common activities. Additionally, functional status was compared between participants of differing lower extremity amputation levels.

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METHODS

Participants

Data from the current study come from a sample of 82 service members with major lower extremity amputation (partial foot and proximal) who reported using a prosthetic device and completed a Wounded Warrior Recovery Project (WWRP) assessment between June and December 2016. Wounded Warrior Recovery Project is a 15-year, web-based longitudinal examination of patient-reported physical and mental health outcomes among US military personnel injured during deployments to Iraq and Afghanistan.[7] Service members injured during deployment are identified for inclusion in the WWRP from the Expeditionary Medical Encounter Database, a casualty tactical and clinical data repository containing medical encounter and injury event information from overseas contingency operations.[8] The Expeditionary Medical Encounter Database provided demographic variables (age, sex, service branch, and rank), as well as injury circumstances and characteristics (injury date, mechanism, and severity and amputation status and timing), for this analysis. The participants were divided into 3 groups depending on amputation site(s): unilateral below knee; unilateral above knee, including knee disarticulation; and bilateral amputation at any level. This study was approved by the Naval Health Research Center Institutional Review Board. This study conforms to all STROBE guidelines and reports the required information accordingly (see Supplemental Checklist, Supplemental Digital Content 1, http://links.lww.com/PHM/A738).

Measures

As part of the WWRP, participants reported their functional status by completing the Orthotics and Prosthetics Users' Survey Lower Extremity Functional Status (OPUS-LEFS). The OPUS-LEFS comprises 20 questions on a wide scope of common functional activities, ranging from "walking indoors" to "run 1 block." The participant rates each item on a scale from 0 (cannot do this activity) to 4 (very easy). The OPUS-LEFS results were reported as a mean total score and standard deviation, as well as a median score for each item, with higher scores indicating better functioning. Typical prosthesis usage for each item is also queried (yes/no). This assessment has demonstrated strong reliability[9] and validity.[10] Date of survey administration was extracted with WWRP survey data allowing for a calculation of time from injury to survey.

Statistical Analyses

One-way analysis of variance with a Tukey post hoc comparison was used to examine the difference in the mean descriptive variables (age at the time of injury, time from injury to survey, and injury severity scale) and OPUS-LEFS total score between amputation categories. The median responses for each item overall and across amputation categories were calculated, and scores for each item were compared across amputation categories using the Krusal-Wallis test. The response for each item was categorized as "very easy/easy" (4 or 3), "slightly difficult/very difficult" (2 or 1), or "cannot do this activity" (0), and then compared across amputation categories with the Fisher exact test. The prosthesis usage response for each item was also compared across amputation categories with Fisher exact test. $P < 0.05$ was considered statistically significant.

RESULTS

The sample included 82 WWRP participants with a major combat-related lower extremity amputation who reported using a prosthetic device. The average age at the time of injury was 29.0 (SD, 6.8) years, and all participants but 1 were male. Overall, the majority were in the Army (76.8%) and enlisted (79.3%) at the time of injury, with the remainder in the Marines (17.1%), Navy (3.7%), and Air Force (2.4%). More than 92% were injured in a blast-related event, and the average Injury Severity Score (ISS) was 16.1 (SD, 8.7). The average time from injury to survey was 7.7 (SD, 3.0) years. Amputation occurred within first 24 hours after injury in 52 participants (63.4%). When delayed, the amputation occurred an average of 1.4 (SD, 1.9) years after injury.

The majority of the sample had a unilateral below-knee amputation (n = 49 [59.7%]), 17 (20.7%) participants had a unilateral above-knee amputation, and 16 (19.5%) had a bilateral amputation. Within the bilateral amputation group, 8 (50%) had bilateral below-knee amputations, 6 (37%) had 1 below-knee amputation and 1 above-knee amputation, and 2 (12%) had bilateral above-knee amputations. Ten of the 82 participants also had at least 1 upper extremity amputation, 2 of which were considered major amputations (partial hand or proximal). As shown in Table 1, the only statistically significant difference between the amputation categories in demographics or injury circumstances was a lower ISS in the below-knee amputation group compared with the other groups ($P < 0.001$).

The mean OPUS-LEFS score was 45.7 (SD, 14.2). There was a statistically significant difference in mean OPUS-LEFS score between the amputation groups (unilateral below knee [49.7], unilateral above knee [41.5], and bilateral [37.8]; $P = 0.004$), with a post hoc analysis determining a significant difference between unilateral below-knee and bilateral amputation mean scores ($P < 0.05$). There were no differences in the mean OPUS-LEFS score between unilateral above knee and the other amputation groups. Additionally, no differences in mean scores were found between those who did and did not have an associated upper extremity amputation or between those with an immediate or late amputation.

Table 2 displays the median rating of each OPUS-LEFS survey item for the total sample, as well as for each amputation category. The easiest activities, reported by the sample as a whole, were getting on/off the toilet and putting on/taking off the prosthesis (group median, 3), whereas the most difficult items were running 1 block (median, 0) and walking up to 2 hours (median, 1). Individuals with unilateral below-knee amputation reported the strongest statistical difference in ease of activity compared with the other amputation groups for rising from a chair (median, 3 vs. 2; $P < 0.001$) and climbing stairs without a rail (median, 2 vs. 1; $P < 0.001$).

After categorizing into "very easy/easy," "slightly difficult/very difficult," and "cannot do this activity," 11 of the 20 survey items demonstrated a statistically significant difference between the amputation groups (Fig. 1). As seen with the lower overall mean scores, participants with unilateral below-knee

TABLE 1. Demographic and injury characteristics by lower extremity amputation status

Characteristics	Unilateral Below Knee (n = 49)	Unilateral Above Knee (n = 17)	Bilateral (n = 16)
Mean (SD) age at time of injury, y	28.1 (6.7)	31.1 (7.3)	29.2 (6.2)
Male, n (%)	49 (100)	17 (100)	15 (93.7)
Service branch, n (%)			
Army	37 (75.5)	14 (82.3)	12 (75.0)
Marine	9 (18.4)	2 (11.8)	3 (18.7)
Air Force/Navy	3 (6.1)	1 (5.9)	1 (6.2)
Rank/pay grade, n (%)			
E1–E3	11 (22.4)	1 (5.9)	2 (12.5)
E4–E6	22 (44.9)	8 (47.0)	10 (62.5)
E7–E9	6 (12.2)	5 (29.4)	0 (0)
Officer	9 (18.4)	4 (25.0)	3 (17.6)
Mission, n (%)			
Iraq	18 (36.7)	11 (64.7)	9 (56.2)
Afghanistan	31 (63.3)	6 (35.3)	7 (43.7)
Injury mechanism, n (%)			
Blast	46 (93.9)	15 (88.2)	15 (93.7)
Gunshot wound/other	3 (6.1)	2 (11.8)	1 (6.3)
Mean ISS, (SD)[a]	12.8 (5.3)	21.3 (8.7)[b]	20.6 (12.3)[b]
Mean (SD) time between injury and survey, y	7.4 (2.9)	8.7 (3.2)	7.7 (2.9)

Continuous variables were compared with ANOVA, and categorical variables were compared with the Fisher exact test.

[a] $P < 0.001$.

[b] $P < 0.05$; Tukey post hoc test with unilateral below knee as the reference group.

TABLE 2. Median scores of OPUS-LEFS items

Item Description	Overall (n = 82)	Unilateral Below Knee (n = 49)	Unilateral Above Knee (n = 17)	Bilateral (n = 16)
Into and out of tub/shower	2	2	2	2
Dress lower body	2.5	3	2	3
On/off toilet	3	3	3	3
Up from floor	2	2	2	2
Balance while standing	2.5	3	3	2
Stand for ½ h[a]	2	2	2	1
Pick up object from floor while standing[b]	2	3	2	2
Up from chair[c]	3	3	2	2
Into and out of car	3	3	2	2
Walk indoors[b]	3	3	3	2.5
Walk outside on uneven ground[a]	2	2	2	1
Walk in bad weather[b]	2	2	2	1
Walk up to 2 h[a]	1	2	1	1
Walk up a steep ramp[a]	2	2	1	1
On/off escalator[a]	3	3	2	2.5
Up 1 flight of stairs with rail[a]	2	3	2	2
Up 1 flight of stairs no rail[c]	2	2	1	1
Run one block[a]	0	1	0	0
Carry plate of food while walking[a]	3	3	3	2
Put on/take off prosthesis	3	3	3	3

Scores for each item across amputation groups were compared using the Kruskal-Wallis test: 0 = cannot do this activity, 1 = very difficult, 2 = slightly difficult, 3 = easy, 4 = very easy.

[a] $P < 0.01$.

[b] $P < 0.05$.

[c] $P < 0.001$.

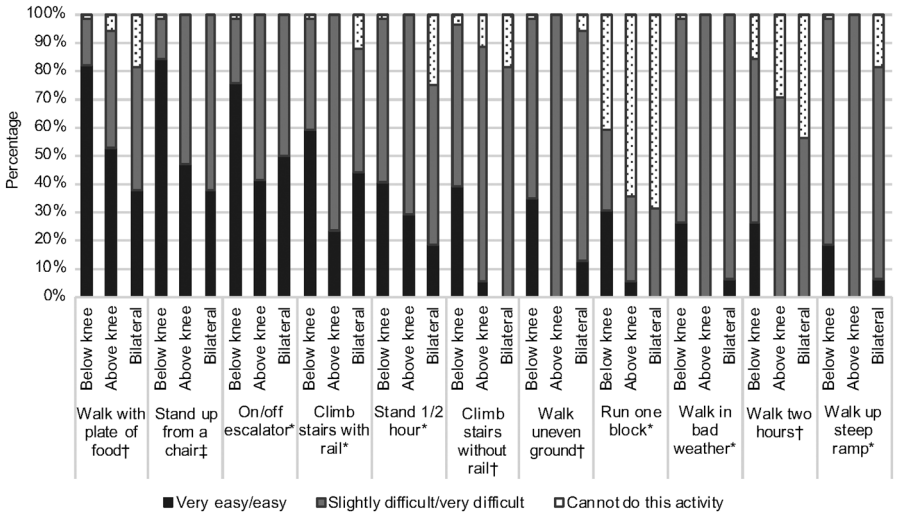

FIGURE 1. Percentages of participants reporting items from the OPUS-LEFS categorized as "very easy/easy," "slightly difficult/very difficult," or "cannot do this activity" by amputation group. Items were compared across amputation groups using the Fisher exact test. Only items with statistically significant differences are shown. *$P < 0.05$; †$P < 0.01$; ‡$P < 0.001$.

amputations demonstrated a consistently greater proportion of reporting items as "very easy/easy," with fewer differences between the other amputation groups. The difficulty with running 1 block is again apparent, with more than 60% of participants with either unilateral above knee or bilateral amputations and 40% of participants with unilateral below-knee amputation reporting the inability to complete that activity, respectively.

A high percentage of prosthesis use was reported across all amputation groups, with 14 of the 20 items having more than 90% reported prosthesis use for the item. The lowest percentage of prosthesis use was reported for getting in and out of tub or shower (17.1%), and highest use was reported for walking on uneven surfaces and walking in bad weather (98.8%). There was a difference in prosthesis usage across the amputation groups for 4 of the 20 survey items (dressing lower body, on and off toilet, up from the floor, and in and out of car), with participants with bilateral amputations reporting the lowest prosthesis use across all 4 items (Fig. 2). While prosthesis use was different in these 4 items, there was not a difference in function in any of these items across the amputation groups. Information on the specific type of prosthetic device used was not available.

DISCUSSION

As assessed by the OPUS-LEFS, the majority of the sample reported basic activities, such as walking indoors, getting on and off the toilet, and getting up from a chair as "very easy/easy," whereas activities requiring more strength and balance, such as climbing stairs, walking long distances, or running, were more often reported as "slightly difficult/very difficult" or "cannot do this activity." The findings of the easiest and most difficult items are consistent with those of Heinemann et al.,[10] although their sample included both prosthetic and orthotic users, whereas the present study included prosthetic users only. The mean OPUS-LEFS in the current study was similar to a mean reported in another study of individuals with a unilateral lower extremity amputation.[9]

When assessing the difference in functional status between the amputation categories, there was a statistically

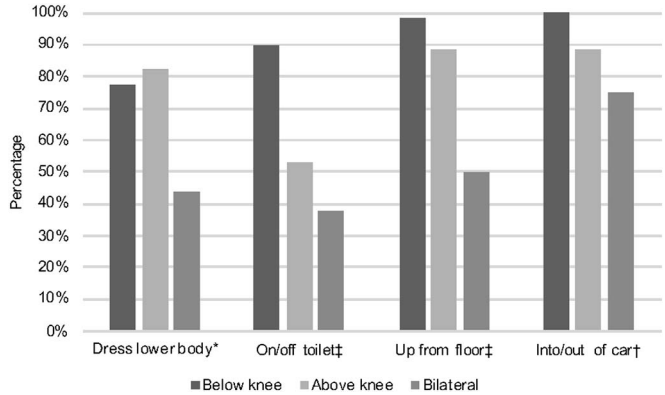

FIGURE 2. Percentage of participants reporting prosthetic use for items on the OPUS-LEFS by amputation group. Items were compared across amputation groups using the Fisher exact test. Only items with statistically significant differences are shown. *$P < 0.05$; †$P < 0.01$; ‡$P < 0.001$.

significant difference in the total OPUS-LEFS score between unilateral below-knee and bilateral amputations, where those with unilateral below-knee amputations reported significantly higher functioning relative to those with bilateral amputations. There were no statistically significant differences observed between the unilateral above-knee amputation group and the other 2 amputation groups. Considering Resnik and Borgia's[9] report documenting a minimal detectable change in the OPUS-LEFS as 10.3, a difference of 11.9 between unilateral below-knee and bilateral amputations in the present study is a clinically significant difference in functioning. The difference in total OPUS-LEFS score between the unilateral below knee and unilateral above knee groups was 8.2, which was not a statistically or clinically significant difference. Perhaps there are fewer differences between these groups, especially in the easier activities, due to the relatively young age of the sample compared with the sample used in Resnik and Borgia's.[9] Additionally, reported prosthesis usage did not appear to influence differences in functioning between the amputation groups as there were no differences in function for the activities where differences in prosthesis use were reported.

Despite the comprehensive rehabilitation provided to service members with combat-related amputations,[11] there are apparent differences between these results on functional status and "ideal" outcomes described by Meier and Melton.[12] Specifically, for activities listed as ideal for each amputation category, 80% in the unilateral below knee group reported walking up a ramp as "slightly difficult/very difficult," 76% in unilateral above knee group reported climbing stairs with a rail as "slightly difficult/very difficult," and 81% in the bilateral group reported walking on uneven ground as "slightly difficult/very difficult." Considering the average time of injury to survey in this study was 8 years, and reports of declines in functional abilities after discharge from rehabilitation,[13] ongoing functional assessments are important to ensure the highest possible level of function. Difficulty in daily functioning may play an important role in quality of life and mental health outcomes, and more research is needed to understand those relationships. Results from the present study highlight areas where function could be improved in relatively young service members with combat-related amputations, especially higher-level activities such as running and prolonged walking, and the importance of using patient-reported outcomes to inform treatment plans.

The primary limitation of this study was the small sample size. This limitation was exacerbated by the unequal group sizes in the amputation categories with unilateral below knee group more than double the size of the other 2 categories. In addition, the cross-sectional study design did not allow for assessing change in function over time. Factors such as height, weight, and type of prosthetic device, which could influence functional status, were not available for analysis.

CONCLUSIONS

These findings reveal potential challenge areas for service members based on the level of amputation and provide targets for rehabilitation professionals to focus efforts on improving daily functioning. Using self-reported functional status of daily activities outlined in this report may help identify activities for patient-centered goals. Future analyses will assess the impact of functional status on patient outcomes, such as quality of life and mental health disorders, including posttraumatic stress disorder and depression.

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14. ABSTRACT

Objective: To describe the functional status of U.S. service members after combat-related amputation.
Design: Cross-sectional analysis of the Wounded Warrior Recovery Project (WWRP), an ongoing, web-based, longitudinal examination of patient-reported outcomes of injured service members.
Setting: Combat casualty care clinic and hospital records; and web-based surveys.
Participants: The sample included 82 WWRP participants with a combat-related lower extremity amputation who reported using a prosthetic device.
Main Outcome Measures: Lower Extremity Functional Status Measure of the Orthotics and Prosthetics User Survey (LEFS-OPUS), which measures self-reported functional status in participants with a prosthetic device.
Results: Basic activities, such as walking indoors, getting on and off the toilet, and getting up from a chair, were reported by the majority of participants as "very easy" or "easy", whereas higher level activities, such as climbing stairs, walking long distances, or running, were reported as "difficult" or "cannot do this activity". Functional status varied significantly by amputation site (unilateral below knee, unilateral above knee, or bilateral; $P = .004$), with significantly better function reported in those with unilateral below knee than bilateral amputation ($P < .05$).
Conclusions: These findings highlight deficits in the functional status of U.S. service members with combat-related amputation. Self-reported functional status of daily activities may help target important activities for patient-centered goals

15. SUBJECT TERMS

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