Biopsychosocial factors and low back pain in military personnel with lower limb loss: the ADVANCE study

Fraje C E Watson ,[1] A N Bennett,[1,2] A McGregor,[3] F Behan,[1,4] N T Fear,[5] C J Boos,[1,6] P Cullinan,[7] S Schofield,[7] A M J Bull[1]

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[1]Department of Bioengineering, Imperial College London, London, UK
[2]Academic Department of Military Rehabilitation, Defence Medical Rehabilitation Centre, Loughborough, UK
[3]Department of Surgery and Cancer, Imperial College London, London, UK
[4]Discipline of Physiotherapy, Trinity College Dublin, Dublin, Ireland
[5]King's Centre for Military Health, King's College London, London, UK
[6]Department of Cardiology, University Hospitals Dorset NHS Foundation Trust, Poole, UK
[7]National Heart and Lung Institute, Faculty of Medicine, Imperial College London, London, UK

Correspondence to
Dr Fraje C E Watson; f.watson@imperial.ac.uk

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ABSTRACT

Introduction Biopsychosocial factors influence low back pain (LBP) in the general population but may affect people with lower limb loss (LLL) differently. The first aim was to investigate the relationship between LBP, disability and injury status. We hypothesised that those with LLL (no lumbosacral injury) will have more LBP and functional disability than those with (i) non-lumbosacral and non-amputation trauma and (ii) a non-injured comparison group, but less LBP and functional disability than those with (iii) lumbosacral trauma. The second aim was to report the biopsychosocial factors of LBP for those with LLL (no lumbosacral injury), stratified by functional disability.

Methods Military and veteran personnel who did ('exposed', n=578) and did not ('unexposed', n=565) sustain combat trauma completed questionnaires for LBP severity, functional disability and biopsychosocial factors. The exposed group was subdivided into participants with lumbosacral injuries (exposed-lumbosacral (Exp-L)), those with LLL and no lumbosacral injuries (exposed-lower limb amputee (Exp-A)) and those with neither LLL nor lumbosacral injuries (exposed-non-lower limb amputee (Exp-NA)). LBP and functional disability were statistically compared for Exp-A versus unexposed, Exp-A versus Exp-L and Exp-A versus Exp-NA. Biopsychosocial factors were descriptively compared for Exp-A with and without functional disability.

Results Exp-A had worse LBP and functional disability than unexposed (both $p<0.001$), less LBP ($p=0.02$) and functional disability ($p=0.001$) than Exp-L, but no different from Exp-NA. Exp-A with functional disability experienced more LBP prior to LLL, higher body mass index, greater current opioid use, increased phantom and residuum pain and higher depression scores than those without.

Conclusion LBP and functional disability were significantly worse in participants with LLL (without comorbid lumbosacral combat injury) than controls, although LBP and functional disability scores were low. Biopsychosocial factors, comorbid non-amputation combat trauma (including lumbosacral), history of LBP, phantom and residuum pain are associated with greater functional disability in people with LLL.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Biopsychosocial factors are important in the presentation of low back pain in the general population.

WHAT THIS STUDY ADDS

⇒ Biopsychosocial factors influence low back pain in military personnel and veterans who sustained a combat injury resulting in lower limb loss.
⇒ History of low back pain prior to lower limb loss, comorbid lumbosacral injury, adverse mental health, phantom limb pain and residuum pain all contribute to low back pain and functional disability in people with traumatic lower limb loss.
⇒ Low back pain and functional disability were significantly worse in UK military personnel and veterans with traumatic lower limb loss (without comorbid lumbosacral combat injury) than a matched military comparison group, although median scores of low back pain and functional disability are low.
⇒ Low back pain and functional disability were not significantly different in UK military personnel and veterans with traumatic lower limb loss (without comorbid lumbosacral combat injury) from those who sustained non-amputation non-lumbosacral combat injuries.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ In the general population, treatment interventions such as cognitive behavioural therapy are being tested to overcome the biopsychosocial complexity of low back pain.
⇒ Treatment interventions that are successful in the general population could be adapted to accommodate the specific needs of people with lower limb loss described here, and outcomes researched.

INTRODUCTION

Low back pain (LBP) is more common in people with lower limb loss (LLL).[1] It has been hypothesised that this is due to high mechanical loading of the lumbar spine and increased pelvic and lumbar muscle recruitment.[2] Additionally, phantom limb pain and residuum pain influence LBP in people with LLL.[3] Less is known about the functional disability resulting from LBP (eg, Oswestry Disability Index (ODI)) in people with LLL, which may be associated with their LBP differently than in the general population.[4]

Consideration of biopsychosocial influences on LBP is widespread, but many biomechanics studies fail to report them, particularly in people with LLL,[5] despite the introduction of a recommended minimum dataset a decade ago.[6] One study of 33 military or veteran personnel with unilateral transtibial LLL found no significant differences for psychosocial factors in those with and without chronic LBP, but did find that unemployment, worse anxiety and worse kinesiophobia were associated with higher ODI scores.[4] The functional consequences of LBP may be more relevant to people with LLL.

A systematic review of biomechanics studies of LBP in people with LLL noted the widespread failure to report any biopsychosocial factors associated with LBP.[7] Studies of people with traumatic amputations fail to report the full extent of the injuries sustained at the time of trauma, particularly those that could affect the incidence of LBP, for example, spinal fractures.[8] Most studies on LBP in people with LLL fail to report history of LBP prior to LLL, which is known to increase the risk of future episodes.[9] Phantom limb pain and residuum pain are thought to contribute to LBP experience in people with LLL due to altered neurobiology and pain processing, but these are often unreported.[5]

Existing literature has compared military veterans with LLL with non-military controls, but this is not necessarily appropriate given the known risks of vigorous activity, load carriage and manual work undertaken by military personnel that are already linked to LBP.[10]

The first aim of this analysis was to investigate the relationship between LBP, disability and injury status. We hypothesised that those who sustain LLL (but not lumbosacral injury) during combat will have higher ODI scores and more LBP than those who (i) sustained non-lumbosacral and non-amputation combat injuries and (ii) a non-injured comparison group, but lower ODI scores and less LBP than those who (iii) sustained lumbosacral injuries. The second aim was to comprehensively report the biopsychosocial factors of LBP for military personnel and veterans with combat-related LLL but without a lumbosacral injury, stratified by functional disability.

MATERIALS AND METHODS

Participants were recruited from serving and veteran UK military personnel who were deployed to Afghanistan between 2003 and 2014.[11] Men were recruited from lists of injured (n=1400) and uninjured (n=2100) personnel provided by Defence Statistics UK. Half of participants sustained a physical combat-related injury requiring aeromedical evacuation to a UK hospital (exposed group). A non-injured comparison group was frequency matched on age, rank, deployment, service and role (unexposed group, figure 1). Exclusion criteria included those with cardiovascular, diabetes or renal disease prior to injury/matched deployment and women.[11] Too few women sustained combat trauma requiring aeromedical evacuation to the UK for sufficient statistical power.

Comprehensive physical and psychosocial data were collected from the Defence Medical Rehabilitation Centre Headley Court (March 2016–August 2018) or Stanford Hall (August 2018 onwards) approximately 8 years postinjury/deployment.[11]

For participants with LLL, height was measured using actual height (87.7% unilateral, 39.5% bilateral), self-reported height (8.6% unilateral, 55.3% bilateral) or source missing (3.6% unilateral, 5.2% bilateral). Weight was measured without prosthetics and adjusted for limb loss.[12] Ethnicity was self-reported.

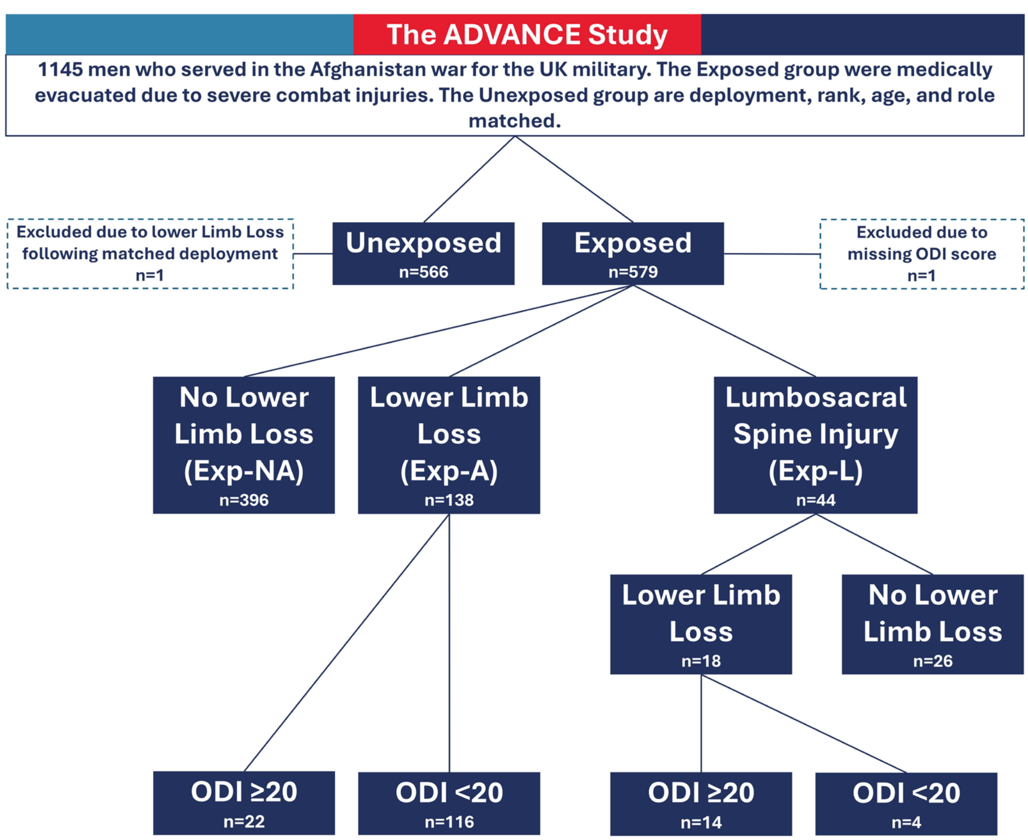

Figure 1 Groups and subgroups of the ADVANCE study used in this analysis. Exp-A, exposed-lower limb amputee; Exp-L, exposed-lumbosacral; Exp-NA, exposed-non-lower limb amputee; ODI, Oswestry Disability Index.

Table 1 Biopsychosocial variables collected in the ADVANCE study in comparison with the recommended minimum dataset as advised by Deyo *et al*[6] and how they were collected

Minimum dataset item	ADVANCE equivalent/proxy	Scoring method
1. How long has back pain been a problem for you?	Have you had chronic back pain >3 months (now or previously)?	Yes/No
2. How often has LBP been an ongoing problem for you in the last 6 months?	How would you score the frequency of your LBP on average in the last week?	0 (none)–10 (constant)
3. In the past 7 days, how would you rate your LBP on average?	How would you score the severity of your LBP on average in the last week?	0 (no pain)–10 (worst pain imaginable)
11. How much did pain interfere with your ability to participate in social activities?	Question 9 of the ODI—how does back pain affect your social life?	0 (My social life is normal and causes me no extra pain) 1 (My social life is normal but increases the degree of pain) 2 (Pain has no significant effect on my social life apart from limiting my more energetic interests, eg, sports) 3 (Pain has restricted my social life and I do not go out as often) 4 (Pain has restricted my social life to my home) 5 (I have no social life because of pain)
13. Have you ever used any of the following treatments for your back pain? (i) Opioid painkillers (if yes, are you currently using them), (ii) injections, (iii) exercise therapy, (iv) psychological counselling	Have you ever taken an opioid medication? (eg, oramorph, MST, tramadol) Are you currently taking an opioid medication?	Yes/No
16. Are you able to do chores such as vacuuming and yard work?	Question 3 of the EQ-5D-5L about usual activities (eg, work, study, housework, family or leisure activities)	1 (I have no problems doing my usual activities) 2 (I have slight problems doing my usual activities) 3 (I have moderate problems doing my usual activities) 4 (I have severe problems doing my usual activities) 5 (I am unable to do my usual activities)
18. Are you able to go for a walk of at least 15 min?	Question 4 of the ODI—how does back pain affect your walking? When providing a score of 1, a respondent asserts that "pain prevents me walking more than 1 mile", which could reasonably take 15 min	0 (Pain does not prevent me from walking any distance) 1 (Pain prevents me walking more than 1 mile) 2 (Pain prevents me walking more than ¼ mile) 3 (Pain prevents me walking >90 m) 4 (I can only walk using a stick or crutches) 5 (I am in bed most of the time and have to crawl to the toilet)
20. In the past 7 days, I felt worthless	Question 6 of the PHQ-9: in the last 2 weeks, how often have you been bothered about the following problems: feeling bad about yourself or that you are a failure or have let yourself or your family down	PHQ-9 questionnaire scores 0–27. Data subcategorised as no depression (0–4) or depression (5+)
21. In the past 7 days, I felt helpless	No direct equivalent within the PHQ-9	
22. In the past 7 days, I felt depressed	Question 2 of the PHQ-9: in the last 2 weeks, how often have you been bothered about the following problems: feeling down, depressed or hopeless?	
23. In the past 7 days, I felt hopeless		
25. In the past 7 days, my sleep was refreshing	Are you satisfied with your sleep?	1 (very satisfied)–4 (very dissatisfied)
26. In the past 7 days, I had a problem with my sleep	Do your sleep problems interfere with daily functioning?	1 (not at all)–5 (extremely)
27. In the past 7 days, I had difficulty falling asleep	Do you have difficulty falling asleep?	1 (none)–5 (very severe)
	Do you have difficulty staying asleep?	1 (none)–5 (very severe)
33. Age	Date of birth is self-reported	Years
34. Sex	All participants in the ADVANCE study are male	n/a
35. Hispanic or Latino ethnicity	Self-reported and manually classified	White, Black, Asian or mixed
36. Race		
37. Employment	Self-reported, manually classified	Military or civilian full-time, part-time, student, athlete, full-time parent, unable to work due to illness, retired, other
39. Smoking	Self-reported	Current smoker, ex-smoker, never smoked
40. Height	Participant height was measured. Where necessary, participants with lower limb loss self-reported their height prior to their injury as this can be affected by use of 'stubbies' or prosthetic leg/s	cm
41. Mass	All participants were weighed. Participants with limb loss were weighed without their prosthetic devices and their mass was adjusted for the body segments they were missing[12]	kg

EQ-5D-5L, EuroQoL 5 Dimensions 5 Levels (for assessing health-related quality of life); LBP, low back pain; MST, morphine sulfate; ODI, Oswestry Disability Index; PHQ-9, Patient Health Questionnaire-9 (for assessing symptoms of depression).

Participants were divided into exposed and unexposed groups, as described above. The exposed group was subdivided into the following three groups: those who sustained injuries that resulted in LLL (exposed-lower limb amputee (Exp-A)), those who did not (exposed-non-lower limb amputee (Exp-NA)) and those who sustained a comorbid lumbosacral combat injury (exposed-lumbosacral (Exp-L)). The latter was defined using Joint Theatre Trauma Registry International Classification of Diseases, Tenth Revision codes,[13] followed by manual review (figure 1). Most Exp-L group injuries were fractures of the lumbosacral spine.

Outcome variables

Back pain severity

Participants scored their back pain severity (BPS) on a scale of 0 (no pain) to 10 (worst pain imaginable). A BPS score of >5 is used to define moderate to severe pain.[14] Participants with a BPS score of >5 were defined as having back pain.

Oswestry Disability Index

The ODI[15] is a self-reported outcome questionnaire used to measure functional disability associated with LBP and is appropriate for use in people with LLL.[4] Participants score 10 activities 0 (no problem) to 5 (complete disability). Adjusted scoring was used for missing values.[15]

The Patient Acceptable Symptom State for the ODI is 5–25 following surgical intervention,[16 17] with no data for healthy or non-surgical LBP populations. This study will consider >20 the threshold for functional disability because this is the threshold between no disability and 'mild disability'.[15] Participants were defined as those with (ODI<20) and without (ODI≥20) functional disability.

Table 2 Demographic information for the unexposed and exposed groups, and exposed subgroups: Exp-NA, Exp-A and Exp-L

	Unexposed	Exposed	Exp-NA	Exp-A	Exp-L
N	565	578	396	138	44
Time since injury/deployment	7.6 (1.6–12.8)	8.2 (1.2–13.8)	8.6 (1.2–13.8)	7.4 (2.3–13.6)	7.6 (2.7–12.7)
Age (years)	34.0 (5.4)	34.0 (5.3)	34.4 (5.6)	33.1 (4.7)	33.6 (5.1)
Height (cm)	178.8 (6.4)	179 (7.0)	179.0 (6.7)	181.2 (7.7)	179.0 (6.2)
Mass* (kg)	87.8 (12.3)	90.1 (14.2)	89.3 (14.1)	91.4 (14.3)	92.4 (14.1)
BMI* (kg/m^2)	27.5 (3.4)	28.1 (3.8)	27.8 (3.7)	28.4 (3.9)	29.0 (3.9)
Race (White)	512 (90.6)	525 (90.8)	358 (90.4)	127 (92.0)	40 (90.9)

Age, height, mass and BMI are presented as mean (SD), time since injury/matched deployment is presented as median (range) and counts are reported with % in brackets.
*Adjusted mass to account for upper and/or lower limb loss.
BMI, body mass index; Exp-A, exposed-amputees; Exp-L, exposed-lumbosacral; Exp-NA, exposed-non-amputees.

Biopsychosocial factors

The ADVANCE study collected exact or proxy results for 22/41 recommended minimum dataset for biopsychosocial factors of LBP[6] (table 1).

Phantom limb pain and residuum pain

Participants with LLL scored their phantom limb pain and residuum pain severity, frequency, and impact from 0 (no pain) to 10 (worst pain imaginable). Each limb was scored individually, and the higher score was reported for people with bilateral LLL.

Statistical analysis

One unexposed participant was removed because he sustained LLL after returning from deployment and one Exp-A participant who did not record an ODI score was removed, so the final sample size was 1143. Continuous variables were assessed for normality by visual inspection. To address the first aim, non-parametric variables were compared between three or more groups using a Kruskal-Wallis test (unexposed vs Exp-NA vs Exp-A vs Exp-L) and post hoc comparisons were tested without adjustment based on predetermined hypotheses (Exp-A vs unexposed, Exp-A vs Exp-NA and Exp-A vs Exp-L; figure 1). These comparisons tested the effect of LLL and non-amputation combat injuries, excluding any potential impact from lumbosacral injuries. Two or more categorical variables were compared using a χ^2 test. No statistical analysis was conducted to address the second aim, as these were based on descriptive analyses only. Statistical tests were carried out in Stata V.18 (StataCorp, Texas, USA) with an α of 0.05.

RESULTS

1143 participants were included (unexposed=565 (49.4%), exposed=578 (50.6%)). In the whole cohort, mean age was 34.1 years (SD 5.4 years), mean height was 179.2 cm (SD 6.7 cm), mean weight was 89.0 kg (SD 13.3 kg) and participants were a median of 8 years (IQR 7–9 years) following injury or matched deployment, with no difference between groups (table 2). Participants self-reported as White (90.7%), Black (4.3%), Asian (3.3%) or mixed (1.7%). The Exp-A group comprised 138 men: 69 unilateral and 69 bilateral amputees. The Exp-L group comprised 44 participants, 18 of whom had LLL: 11 unilateral and seven bilateral amputees.

Unexposed versus Exp-NA versus Exp-A versus Exp-L

BPS and ODI were significantly different across groups (both $p<0.001$, table 2 and figure 2). Post hoc comparisons of predetermined hypotheses are below.

Exp-A versus unexposed

BPS and ODI were higher in the Exp-A group compared with the unexposed group (median: 2 vs 1 and median: 6 vs 2, both

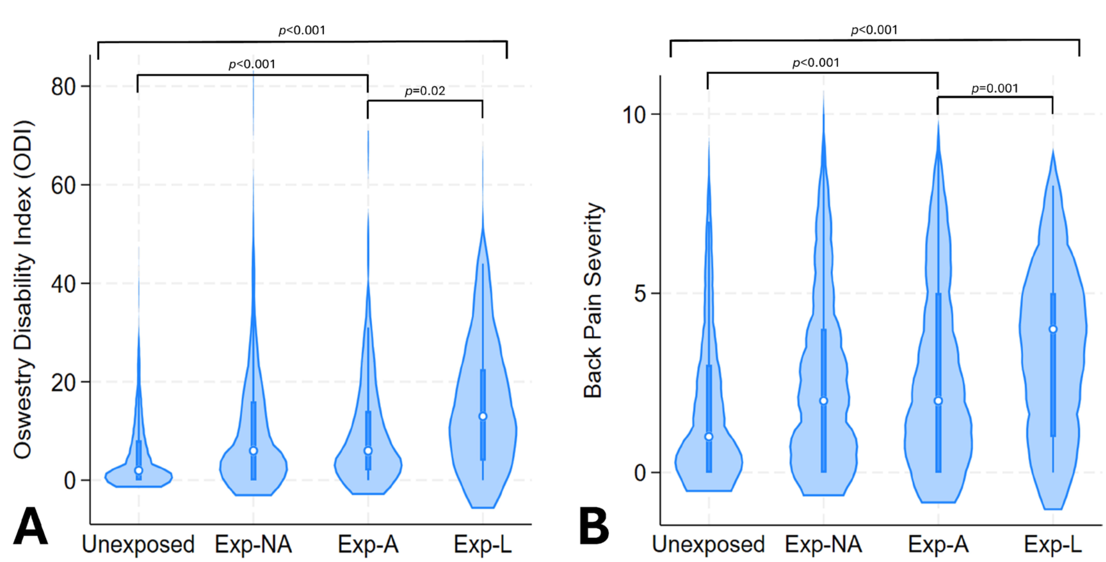

Figure 2 (A) Violin plots of Oswestry Disability Index (ODI) of low back pain-related disability in the unexposed, exposed-non-amputee (Exp-NA), exposed-amputee (Exp-A) and exposed-lumbosacral (Exp-L) groups. (B) Violin plots of ODI of back pain severity in the unexposed, Exp-NA, Exp-A and Exp-L groups.

Table 3 Median and IQR back pain severity and ODI scores for the unexposed and exposed subgroups: Exp-NA, Exp-A and Exp-L

	Unexposed	Exp-NA	Exp-A	Exp-L
N	565	396	138	44
Back pain severity	1.0 (0.0–3.0)[a]	2.0 (0.0–4.0)	2.0 (0.0–5.0)[ab]	4.0 (1.0–5.0)[b]
ODI	2.0 (0.0–9.0)[c]	6.0 (0.0–16.0)	6.0 (2.0–14.0)[cd]	13.0 (4.0–22.5)[d]

P<0.05 between pairs of letters a–d, for example, for back pain severity, unexposed and Exp-A both have an a, showing that there is a significant difference between this pair.
Exp-A, injured-amputees; Exp-L, injured-lumbosacral; Exp-NA, injured-non-amputees; ODI, Oswestry Disability Index.

p<0.001, table 3 and figure 2). More Exp-A participants had back pain (28.8% vs 8.9%, p<0.001) and functional disability (15.8% vs 5.5%, p<0.001) than unexposed participants.

Exp-A versus Exp-NA

BPS and ODI did not differ between Exp-A and Exp-NA groups (median: 2 vs 2 and median: 6 vs 6, both p=1.00, table 3 and figure 2). However, significantly more Exp-A participants had back pain (28.8% vs 14.7%, p<0.001) than Exp-NA participants, but there was no difference for prevalence of functional disability (15.8% vs 14.9%, p=0.769).

Exp-A versus Exp-L

BPS and ODI were higher in the Exp-L compared with the Exp-A group (median: 4 vs 2 and median: 13 vs 6, p=0.02 and p=0.001, table 3 and figure 2). There was no difference in the number of Exp-L and Exp-A who had back pain (22.7% vs 28.8%, p=0.43), but there was only weak evidence that more Exp-L participants had functional disability (29.6% vs 15.8%, p=0.05).

Biopsychosocial factors of LBP in the Exp-A group

Biopsychosocial factors associated with LBP in the Exp-A group are reported and stratified by those with and without functional disability in table 4. Of note are the distributions of body mass, BMI, race, experience of LBP prior to LLL, depression score, current use of opioids, phantom limb pain and residuum pain (table 4). Equivalent data are available for the Exp-L group in online supplemental table A.

DISCUSSION

The first aim was to investigate the relationship between LBP, disability and injury status. As we hypothesised, there were worse LBP severity and ODI scores in participants with LLL (without comorbid lumbosacral injury) compared with an uninjured military comparison group. Contrary to our hypothesis, BPS and ODI scores were no different for participants with LLL compared with participants who sustained non-amputation combat injuries (both without comorbid lumbosacral injury). As expected, there were lower LBP severity and ODI scores in participants with LLL (without comorbid lumbosacral injury) compared with those that sustained a lumbosacral injury.

The second aim was to describe biopsychosocial factors of LBP for military personnel and veterans with combat-related LLL but without a lumbosacral injury for the first time. We consider the association of LBP-related functional disability and those biopsychosocial factors, and detail important contributions from comorbid lumbosacral injuries and the presence of LBP prior to amputation. Overall, these results demonstrate the influence of biopsychosocial factors, complex combat trauma, prior LBP and comorbid lumbosacral injury on LBP and disability in people with LLL, which should inform study design and reporting of future research. People with LLL may experience a different interplay between functional and biopsychosocial determinants and consequences of LBP than the general population with LBP.

Exp-A versus unexposed

Farrokhi *et al*[18] reported increased odds for developing a lumbar spine musculoskeletal injury 1 year following LLL compared with 1 year following a minor leg injury in military personnel. We found increased BPS and ODI scores in people with LLL (without lumbosacral injury) compared with unexposed participants, which supports the work by Farrokhi *et al* and presents long-term outcomes resulting from LLL.

Exp-A versus Exp-NA

Higher prevalence of LBP in people with LLL compared with controls has been most commonly attributed to loss of muscle mass and altered gait biomechanics[2 19] required to maintain stability, overcome fatigue and control a prosthetic device.[20] This study found no difference in BPS or ODI scores between Exp-A and Exp-NA groups, but did find that more Exp-A participants exceeded the threshold for BPS. Experience of LBP and associated functional disability may be different for LLL compared with other injury types. Overall, these results suggest that additional factors alongside the biomechanical effects of LLL may be contributing to LBP and higher ODI scores. The biomechanical implications of LLL on LBP may take longer to develop than the mean 8 years postamputation reported in this study, although this is longer postamputation than reported in many biomechanics studies of LBP in people with LLL.[19] Participants in this study with LLL all sustained complex major combat injury, so they may have additional injuries that could contribute to LBP or higher ODI scores, which is likely to be true for veteran participants with LLL in other studies.

Exp-A versus Exp-L

Due to the complex nature of combat injuries sustained by this population and the known effect of lumbar injury on subsequent LBP,[10] we included a separate group for participants with and without LLL who sustained a lumbosacral injury in combat (Exp-L). As expected, this group had more severe LBP and higher ODI scores than the Exp-A group. Clearly, prior LBP and comorbid lumbosacral injury are important factors in the prevalence and experience of LBP in people with LLL, rather than solely the amputation status.

Studies on people with LLL routinely fail to report the presence of LBP prior to the amputation injury and comorbid combat lumbar spine injuries,[7] which are both known to contribute to subsequent LBP.[10] Our study found a history of LBP in ∼10% of participants with LLL overall, and higher prevalence in people with LLL with functional disability.

Biopsychosocial factors of LBP in the Exp-A group

Here, we consider our descriptive results within the broader literature on biopsychosocial factors of LBP.

Body mass index

Our findings suggest that people with LLL (without comorbid lumbosacral injury) with functional disability have a higher BMI than those without functional disability, although causal influence is impossible to distinguish. Obesity is a known risk factor for LBP in the general population,[10] but a meta-analysis of studies comparing people with LLL with and without LBP did not find weight to be different between groups.[7] ADVANCE study participants were weighed without prosthetics, and an adjusted mass was calculated.[12] Of the four papers reporting weight, none explained how it was measured (eg, with/without prosthetics, with/without adjusted mass), which inhibits interpretation and comparison.[7]

Race

We found that a higher percentage of non-White participants with LLL experienced functional disability than did not, although this finding is descriptive and in low numbers. All 11 non-White participants in the Exp-A group were of junior ranks (indicative of lower socioeconomic status in the UK military),[21] suggesting socioeconomic status has some part to play. A recent cohort study of 9088 patients with acute LBP found that Black and Hispanic patients were more likely to progress to chronic LBP than White patients, but this relationship was only partially mitigated by socioeconomic status.[22]

Mental health

Mental health comorbidities are known risk factors for LBP,[10] and psychological treatment interventions have been shown to improve LBP outcomes.[23] We present evidence of increased depression scores in people with LLL and functional disability, although this is not the same as a clinical diagnosis of depression. This finding mirrors national survey results which found 3.9 times increased odds for back pain being 'extremely bothersome' in people with LLL if they had a depressed mood compared with those without,[1] and more severe depression and post-traumatic stress disorder in people with LLL with recurrent LBP compared with those without.[24] Participants with LLL in the ADVANCE study have been shown to report overall low levels of anxiety and depression, similar to those reported in the unexposed group.[25] With this perspective, the increased depression scores observed in Exp-A participants with functional disability are impactful.

Phantom limb pain and residuum pain

We found higher phantom limb and residuum pain scores in people with LLL and functional disability, with and without comorbid lumbosacral injury. Phantom limb syndrome is associated with a 2.3 times increased odds for LBP[26] and significantly decreases the time to medical presentation for LBP.[27] It is thought that phantom limb pain is caused by altered peripheral and central nervous system processing, which could affect LBP chronicity.[10 28] Concurrent pain in other body sites is a known risk factor for LBP,[10] and participants with LLL and LBP noted increased LBP during episodes of phantom limb pain.[20]

Opioid use

Current opioid use was higher in the Exp-A group with functional disability compared with those without. Long-term prescription of opioids for chronic non-specific LBP is discouraged,[29] although participants in our study may represent those with complex and/or relapsing pain profiles, potentially increasing rates of opioid use.

Table 4 Biopsychosocial factors associated with LBP for participants with LLL and without lumbosacral injuries in the exposed-amputees group

	No functional disability	Functional disability
N	116	22
Age (years)	32.8 (4.7)	34.6 (4.2)
Height (cm)	181.8 (7.3)	178 (9.0)
Mass* (kg)	90.9 (14.7)	93.7 (12.0)
BMI* (kg/m^2)	27.5 (3.9)	29.6 (3.1)
Race		
White	111 (95.7%)	16 (72.7%)
Other	5 (4.3%)	6 (27.3%)
PHQ-9 (0–27)	2 (0–27)	6 (1–27)
LBP prior to combat injury (yes)	9 (6.9%)	4 (18.2%)
Back pain for >3 months (yes)	15 (12.9%)	9 (40.9%)
Back pain frequency (0–10)	1 (0–9)	6.5 (0–10)
Back pain severity (0–10)	2 (0–7)	6 (0–9)
Opioid use		
Ever used	95 (87.2%)	18 (85.7%)
Currently using	4 (3.5%)	7 (31.8%)
Amputation (unilateral)	57 (49.1%)	12 (54.6%)
Amputation level∞		
Transtibial	45 (38.8%)	8 (36.4%)
Knee disarticulation	9 (7.8%)	1 (4.6%)
Transfemoral	62 (53.5%)	13 (59.1%)
Phantom limb pain		
Severity (0–10)	2 (0–9)	5 (0–10)
Frequency (0–10)	2 (0–8)	3 (0–10)
Impact (0–10)	0 (0–9)	3 (0–8)
Residuum pain		
Severity (0–10)	2 (0–9)	3 (0–10)
Frequency (0–10)	2 (0–10)	3 (0–10)
Impact (0–10)	1 (0–10)	4 (0–9)
Sleep		
Sleep satisfaction	2 (1–4)	2 (2–4)
Sleep problems	2 (1–4)	3 (1–5)
Difficulty fallingasleepp	2 (1–4)	3 (1–5)
Difficulty staying asleep	2 (1–4)	3 (1–4)
Smoking		
Never smoked	56 (48.3%)	10 (45.5%)
Ex-smoker	36 (31.0%)	10 (45.5%)
Current smoker	24 (20.7%)	2 (9.1%)
Employment		
Full-time/Part-time work	64 (55.2%)	12 (54.6%)
Unable to work or retired	19 (16.4%)	5 (22.7%)
Unknown/Other	33 (28.4%)	5 (22.7%)
Able to walk for >15 min (0–5)	0 (0–2)	1 (0–4)
Able to do chores (0–5)	1 (1–5)	2 (1–5)

These are stratified by 'no functional disability' (ODI ≤20) and 'mild or more functional disability' (ODI >20).
Age, height, mass and BMI were parametric so are presented as mean (SD), counts are reported with % in brackets, and all other scores were non-parametric so are presented as median (range).
*Adjusted mass to account for upper and/or lower limb loss ∞level of highest amputation reported for people with bilateral lower limb loss.
BMI, body mass index; LBP, low back pain; LLL, lower limb loss; ODI, Oswestry Disability Index; PHQ-9, Patient Health Questionnaire-9.

Potential for rehabilitation

In the general population, treatment interventions such as cognitive behavioural therapy are being tested to overcome the biopsychosocial complexity of LBP.[30] These methods could be adapted to accommodate the specific needs of people with LLL described here. However, researchers should be aware of additional layers of complexity for people with LLL. Anecdotal conversations have identified issues such as residuum wounds impacting LBP through gait adaptations, inability to use prosthetics or a long wait for a new socket making them unable to carry out their usual positive behaviours to control LBP and reduced mental health due to temporary reduced mobility and increased pain.

Limitations

This analysis does not address the existing age and gender imbalances in research on people with LLL and LBP and, therefore, cannot be generalised to female, older adults or people with atraumatic LLL. We report 22/41 recommended items associated with LBP, so additional aspects (eg, other pain source, history of spinal fusion, education, receipt of disability benefits, beliefs) may affect people with LLL that have not been mentioned here. Causal inference is limited in this cross-sectional analysis.

CONCLUSION

This analysis has presented biopsychosocial factors of LBP in people with LLL and highlights their value. We have shown how non-amputation combat injuries, presence of LBP prior to amputation, comorbid lumbosacral spine injuries and perception of pain linked to phantom limb and residuum pain are all important contributors to the presence of LBP in people with LLL. In the largest population of military personnel with LLL in recent literature, we have shown that people with LLL have greater LBP severity and ODI scores than a military comparison group, but these are no different from military personnel with non-amputation combat injuries. Better understanding of the mediation of LBP and ODI scores by biopsychosocial factors in people with LLL will help improve and refine the understanding of biomechanics changes and could improve treatment outcomes.

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ORCID iD

Fraje C E Watson http://orcid.org/0000-0003-3716-9267

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