

The Influence of Socio-economic Deprivation on Mobility, Participation, and Quality of Life Following Major Lower Extremity Amputation in the West of Scotland

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WHAT THIS PAPER ADDS

This study demonstrates that there is a high proportion of people from socially deprived areas who undergo a lower extremity amputation due to vascular disease. It highlights the detrimental association between social deprivation and quality of life, specifically with reference to limb fitting, mobility, and participation at one year after amputation.

Objective: Lower extremity amputation (LEA) is more common in people from lower socio-economic groups. This study examined this further by investigating the influence of socio-economic status on mobility, participation, and quality of life (QoL) after LEA.

Methods: Prospective data were gathered for all LEAs performed in one year in one Scottish Health Board, commencing March 2014. A postcode derived Scottish Index of Multiple Deprivation (SIMD) was applied by quintile (SIMD 1 = most deprived). Routine data were collected on the cohort of 171 patients; 101 participants consented and received postal questionnaires on QoL (EQ-5D-5L), participation (Reintegration to Normal Living Index [RNLI]), and mobility (Prosthetic Limb User Survey of Mobility), six ($n = 67$) and 12 months ($n = 50$) after LEA.

Results: The mean \pm SD age of the cohort was 66.2 ± 11.4 years; 75% were male and 53% had diabetes. In total, 67% lived in SIMD 1 and 2 and 11.1% in SIMD 5. Sixty per cent had a transtibial amputation. Mortality was 6% at 30 days 17% at six, and 29% at 12 months. Those in SIMD 1 were significantly younger (62.9 years) than those in SIMD 5 (76.3 years). Significantly more participants with a transfemoral amputation (TFA) lived in SIMD 1 (44%) compared with SIMD 5 (11%) ($p = .004$). Participation was low (RNLI scores: 6 months = 55.7; 12 months = 56.6) and PLUS M scores suggested mobility was poor overall at six (39.1) and 12 months (38.9). Mean QoL was 0.37 at 6 months and 0.33 at 12 months.

Conclusion: Although this study observed more LEAs in those from low socio-economic areas, it is impossible to conclude whether QoL after LEA is truly influenced by socio-economic status. There was an association between the disproportionately high rate of LEAs in SIMD groups 1 and 2 and the high prevalence of smoking, 61% vs. only 21% of those in the least deprived areas (SIMD 3, 4, and 5) being current smokers.

Keywords: Lower extremity amputation, Quality of life, Scottish index of multiple deprivation

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INTRODUCTION

Low socio-economic status is associated with poor health.^{1–3} Those living in deprived areas are more likely to exhibit

features of unhealthy lifestyles, such as smoking, low levels of physical activity, and obesity.⁴ Peripheral arterial occlusive disease (PAOD) and its ischaemic complications are also strong determinants of poor health.⁵ Many who have lower extremity amputations (LEA) due to PAOD will also have other comorbidities, the most common of which are diabetes and renal disease. There is a higher risk of PAOD related LEA in those of lower socio-economic status, when these comorbidities have been accounted for.⁶

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PAOD is the most common cause of major LEA, and rates of LEA are 65% higher in areas of low socio-economic status.⁴ Only 40% of people who have a LEA will receive a prosthetic limb.⁷ Quality of Life (QoL) after LEA is known to be poor and this is determined by the ability to walk with prosthesis, as well as level of amputation, psychological motivation, living situation, and social function.⁸ QoL is also generally poorer in those from more deprived areas, owing to factors such as poorer housing and limited access to community services.^{3,9}

Scotland is ranked the fourteenth wealthiest country in the world, according to the Organisation for Economic Co-operation and Development.¹⁰ Almost half (47%) of the population of Greater Glasgow & Clyde Health Board (GG&CHB) reside in areas ranked within the 20% most deprived areas in Scotland. In contrast, only 4% of the population in GG&CHB live in the 10% of the least deprived areas in Scotland.

The aim of this study was to determine the influence of socio-economic status (SES) on mobility, participation, and QoL following LEA of those living in GG&C. Other outcomes, such as level of LEA, limb fitting, and mortality, were also examined.

METHODS

This study was approved by the National Health Service (NHS) West of Scotland Research Ethics Committee 3, 14/WS/0016. One hundred and seventy-one people underwent supramalleolar LEA (classified as major LEA) under the care of the vascular surgeons in NHS GG&C between 1 March 2014 and 28 February 2015. A clinical review of 171 medical case notes was undertaken at the time of LEA, and six and 12 months afterwards. One hundred and one patients consented to complete follow up questionnaires on QoL, participation, and mobility six and 12 months after LEA, and 70 were unable to consent to follow up owing to cognitive deficits or other comorbidities.

SES at time of LEA was classified by the Scottish Index of Multiple Deprivation (SIMD). SIMD, determined by residential postcode, is derived from several factors, including household income, school attainment, travel time to general practitioners, health measures, crime, and unemployment rates.¹¹ Nationally, there are 6976 data zones, ranked by deprivation score, which are categorised discretely. Commonly, the national data are expressed by quintile, with SIMD 1 being the most deprived and SIMD 5 the least deprived.¹²

The electronic patient records and therapy notes were examined for health data, including socio-demographic descriptors, at the time of amputation, and six and 12 months later. Level and date of initial LEA and 30 day mortality were recorded alongside any further operative procedures, length of hospital stay, discharge destination, and referral for prosthetic fitting. LEA level was categorised as transtibial (TTA), transfemoral (TFA), bilateral transtibial, and bilateral transfemoral, and TTA & TFA. The data for the small number of people who underwent a through knee

amputation ($n = 3$) were included in the TFA group, owing to similarities in prosthetic prescription. Other demographic variables were age, sex, ethnicity, education, and employment. Social situation referred to whom the participant lived with, if anyone at all. Type of housing differentiated between social housing, owner/occupier, or nursing home. Wheelchair accessibility within the home was assessed by an occupational therapist and categorised into either full access, housebound, or restricted access to essential rooms (i.e., single room living). The Functional Co-morbidity Index (FCI) was used to assess the level of multi-morbidity.¹³ Smoking status and excessive alcohol consumption (>14 units per week) were also recorded.

Follow up questionnaires

In addition to the medical case note review, patients who were able to understand English, were medically fit after their LEA, and able to give written informed consent were asked to complete postal questionnaires on QoL (EQ-5D-5L), participation (Reintegration to Normal Living Index [RNLI]), and prosthetic mobility (Prosthetic Limb User Survey of Mobility [PLUS-M]) (described below). Response rates were 66.3% ($n = 67$) and 49.5% ($n = 50$) at six and 12 months, respectively.

The QoL measure (EQ-5D-5L) assesses health over five domains: mobility, self care, usual activities, pain/discomfort, and anxiety/depression, using a Likert scale ranging from 1 to 5 (Herdman *et al.*, 2011).¹⁴ The scores in the five domains are converted to a health index from the EuroQol calculator, ranging from -0.6 (the poorest health related QoL) to $+1$ (the best health related QoL).¹⁵ A health index < 0 represents a quality of life "worse than death".

Participation was measured with the RNLI, which assesses, quantitatively, the degree to which an individual who has experienced a traumatic or incapacitating illness achieves re-integration into normal social activities.¹⁶ There are 11 statements relevant to social participation (e.g., "I move around my community as I feel necessary" and "I assume a role in my family which meets my needs and those of other family members"). Each statement is rated from 0 (unable to perform) through to 10 (able to perform fully), generating a maximum score of 110.¹⁶ This is converted into an adjusted score with a maximum of 100; greater scores represent higher levels of integration and hence participation.

The PLUS-M (12 item short form v1.2) was only completed by those who had received a prosthesis. This questionnaire, comprising 12 activity statements, asked the respondents to rate their ability to perform physical tasks while wearing their prosthesis. PLUS-M scores are converted to a t score, which ranges from 21.8 (unable to walk at all) to 71.4 (independent walking with no walking aids).¹⁷

Statistical analysis

The study variables were summarised using descriptive statistics. Continuous variables are expressed as means \pm SD

and were grouped by SIMD quintile for comparison. Chi-square tests were applied to the differences between SIMD quintile and predictor variables, for example limb fitting and level of LEA. One way analysis of variance (ANOVA) was conducted to explore differences between SIMD quintiles and outcome variables, for example QoL, participation, and mobility. Post-hoc analysis was also used for between groups testing. Logistic regression was used to determine associations between mortality and SES.

RESULTS

Cohort characteristics

There were 171 patients who underwent a major LEA in one year (1 March 2014–28 February 2015) in GG&C (Table 1). Mean age was 66.2 ± 11.4 years; 75% were male ($n = 128$). Almost two thirds (67%) of the cohort lived in SIMD 1 and 2 and there was a statistically significant difference in age at time of LEA across the SIMD quintiles ($p < .001$), with those in the most deprived area (SIMD 1) being, on average, 13 years younger (62.9 ± 10.6 years) than those in the least deprived area, SIMD 5 (76.3 ± 12.0 years). Bonferroni post-hoc analysis found statistically significant differences in age between SIMD 1 and SIMD 5 ($p < .001$), between SIMD 2 and 5 ($p = .047$), and between SIMD 3 and 5 ($p = .009$).

More patients had a TTA (60%, $n = 103$) than a TFA (40%, $n = 68$), and those with a TFA were older than those with a TTA (mean 67.7 years and 65.2 years, respectively; $p = .030$). More of those with a TFA lived in the lower socio-economic quintiles ($p = .037$; Table 1).

Socio-economic status

High levels of socio-economic deprivation were found in this cohort. Almost half of the cohort (44%) lived in the most deprived area (SIMD 1), whereas only 11% lived in the least deprived area. Almost a quarter of the cohort lived in SIMD 2 (23%), whereas the remaining 20% lived in SIMD 3 (16%) and SIMD 4 (5%), which was disproportionate to both the GG&CHB and Scottish populations (Fig. 1).

Overall, 17% ($n = 29$) of the cohort had already undergone LEA (i.e., prior to the study). Of these, two participants underwent LEAs to a higher level and 27 became bilateral amputees; thus, 16% of the study cohort were bilateral amputees. However, during inpatient stay 30 participants underwent revision or further amputation resulting in a total of 34% ($n = 58$) of the cohort being bilateral amputees when discharged home. There was no statistically significant difference between the SIMD quintile and becoming a bilateral amputee ($p = .708$).

Approximately half of the study population (50%, $n = 85$) achieved prosthetic fitting at discharge from rehabilitation. When prosthetic fitting was compared across SIMD quintiles there were no statistically significant differences ($p = .100$), despite higher numbers of those in SIMD 5 being fitted with a prosthesis compared with SIMD 1–4, despite being, on average, 10 years older than the whole cohort (Table 1).

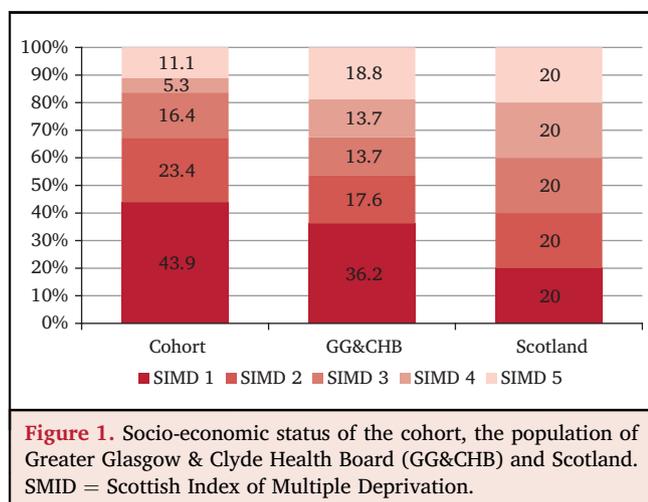
Other characteristics were compared across the socio-economic groups (Table 2). There was a statistically significant difference between SIMD quintile and level of

Table 1. Description of the cohort by socio-economic status ($n = 171$)

Scottish Index of Multiple Deprivation (SIMD) quintile	Total $n = 171$ (100%)	SIMD 1 $n = 75$ (43%)	SIMD 2 $n = 40$ (23%)	SIMD 3 $n = 28$ (16%)	SIMD 4 $n = 9$ (5%)	SIMD 5 $n = 19$ (11%)	<i>p</i> -value
Mean \pm SD age (y)	66.2 ± 11.4	62.9 ± 10.6	68.0 ± 9.3	65.6 ± 11.6	65.8 ± 12.8	76.3 ± 12.0	<.001 ^a
Male	128 (75)	57 (76)	32 (80)	22 (79)	6 (67)	11 (58)	.400
Mean \pm SD Functional Co-morbidity Index ^a	5.053 ± 2.25	5.213 ± 2.37	4.900 ± 2.20	5.036 ± 2.15	4.678 ± 1.59	4.947 ± 1.94	.930
Excess alcohol consumption	26 (15)	14 (19)	8 (20)	3 (11)	0	1 (5)	.188
Currently smoking	82 (48)	44 (59)	26 (65)	10 (36)	1 (11)	1 (5)	<.001 ^a
White	166 (97)	73 (97)	40 (100)	28 (100)	6 (67)	19 (100)	<.001 ^a
Further education	14 (8)	3 (4)	1 (3)	2 (7)	1 (11)	7 (37)	<.001 ^a
Retired	119 (69)	40 (53)	33 (83)	20 (71)	7 (78)	19 (100)	<.001 ^a
Social housing	89 (52)	51 (68)	24 (60)	9 (32)	3 (33)	2 (11)	<.001 ^a
Living alone	64 (37)	37 (49)	13 (33)	7 (25)	3 (33)	4 (21)	.139
Diabetes	91 (53)	38 (51)	19 (48)	19 (68)	7 (78)	8 (42)	.181
<i>At discharge home</i>							
Transtibial amputation (TTA)	75 (44)	31 (41)	12 (30)	16 (57)	6 (67)	10 (53)	.037
Transfemoral amputation (TFA)	63 (37)	33 (44)	20 (50)	5 (18)	0	5 (26)	
Bilateral TTA	13 (8)	5 (7)	0	4 (14)	1 (11)	3 (16)	
Bilateral TFA	10 (6)	4 (5)	3 (8)	1 (4)	1 (11)	1 (5)	
TTA & TFA	10 (6)	2 (3)	5 (13)	2 (7)	1 (11)	0	
Housebound	132 (77)	58 (77)	30 (75)	24 (86)	6 (67)	14 (74)	.950
<i>At discharge from rehabilitation</i>							
Limb Fitted	85 (50)	35 (47)	15 (38)	16 (57)	5 (56)	14 (74)	.100

Data are n (%) unless otherwise indicated. p value is the result of comparing each variable by SIMD quintile using chi-square for categorical variables and analysis of variance for age and Functional Co-morbidity Index. TTA = transtibial amputation; TFA = transfemoral amputation; SD = standard deviation.

^a >1 decimal place due to small numbers in Functional Co-morbidity Index.



amputation ($p = .037$; Table 1). Post-hoc analysis found that the only nominally significant difference was the finding that more patients had a TFA than a TTA in SIMD 2 ($p = .045$); however, there were no other statistically significant differences in level of LEA for the remaining SIMD quintiles: SIMD 1 ($p = .920$), SIMD 3 ($p = .089$), SIMD 4 ($p = .271$), and SIMD 5 ($p = .072$). More patients who lived in SIMD 1 smoked than in the other quintiles, and the highest number who consumed excess alcohol lived in the two most deprived areas. Additionally, more of those in SIMD 1 lived in social housing than in other areas.

Mortality following LEA was 6% 30 days after surgery and increased to 17% ($n = 30$) at six months and 29% ($n = 50$) at 12 months. Logistic regression analysis found no statistically significant difference between SIMD quintiles and mortality at 30 days ($p = .141$), six months ($p = .295$), or 12 months ($p = .468$). There was no significant difference between SIMD quintiles and the number of comorbidities, measured by the FCI ($p = .930$).

One hundred and one patients consented to completing follow up questionnaires; 67 were completed at six months and this reduced to 50 at 12 months. Follow up at six

months found more patients who completed questionnaires were limb fitted and did not smoke ($p = .037$ and $p < .001$, respectively) than those who did not complete the questionnaires. Other variables did not vary significantly between the two groups. There were no statistically significant associations between SIMD quintiles and those who did and did not complete follow up questionnaires ($\chi^2 (4, n = 171) = 3.568$; $p = .468$).

Quality of life six months after LEA was lower in those returning questionnaires 0.37 ± 0.37 vs. the population norm in the UK of 0.79 (for those aged 65–75 years).¹⁸ A one way ANOVA demonstrated no association between SIMD and QoL at six months ($F (4, 62) = 1.7, p = .161$) or 12 months ($F (4, 45) = 2.0, p = .111$). Over a quarter (27%, $n = 8$) of participants who completed the questionnaire and lived in the most deprived area (SIMD 1) scored their QoL as < 0 , representing a quality of life “worse than death” (Figs 2 and 3).

There was a non-significant association between higher levels of participation (RNLI) and lower levels of deprivation (SIMD) at six months ($p = .057$). Mobility was poor for all those who were fitted with a prosthesis; however there were no statistically significant differences across the SIMD quintiles at six or 12 months following LEA ($p = .628$ and $p = .164$, respectively; Table 2).

DISCUSSION

This prospective longitudinal cohort study assessed QoL and SES in those undergoing LEA due to PAOD and/or diabetes. It was observed that the majority of those (67%) undergoing LEA lived in the most deprived areas of GG&CHB, and this had a negative impact on QoL. The association between higher rates of LEA and increasing deprivation has been identified previously. Ferguson *et al.* retrospectively examined 327 people who underwent both minor and major LEAs in a six year period of one district general hospital in England, and found that LEAs were more prevalent in deprived areas.⁴

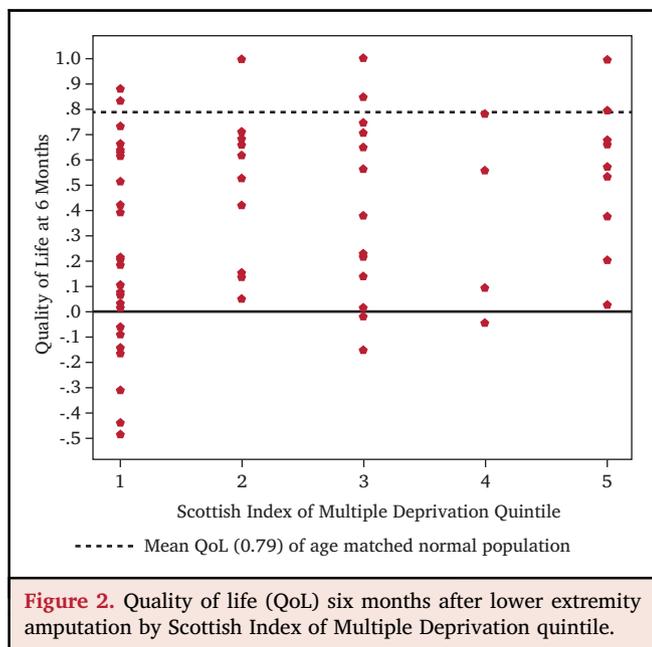
The current study reports a significant difference in mean age when undergoing LEA across socio-economic groups,

Table 2. Results of follow up questionnaires six and 12 months after lower extremity amputation (LEA) by Scottish Index of Multiple Deprivation (SIMD) quintile.

	All Cohort	SIMD 1	SIMD 2	SIMD 3	SIMD 4	SIMD 5	p-value
6 Months Post LEA	(n=67)	(n=30)	(n=11)	(n=13)	(n=4)	(n=9)	
EQ-5D-5L	0.37 (± 0.37)	0.26 (± 0.39)	0.51 (± 0.29)	0.41 (± 0.37)	0.35 (± 0.39)	0.54 (± 0.30)	.161
RNLI	55.7 (± 23.3)	47.8 (± 24.6)	61.8 (± 21.6)	55.7 (± 23.9)	62.5 (± 16.8)	71.9 (± 11.0)	.057
PLUS-M (t-score) (n=50)	39.1 (± 11.8)	37.4 (± 10.5)	42.5 (± 8.1)	37.2 (± 15.9)	47.1 (± 0.9)	40.8 (± 13.4)	.628
Limb Fitted	82.1% (55)	76.7% (23)	81.8% (9)	92.3% (12)	50.0% (2)	100% (9)	.026*
12 Months Post LEA	(n=50)	(n=17)	(n=11)	(n=10)	(n=4)	(n=8)	
EQ-5D-5L	0.33 (± 0.39)	0.23 (± 0.38)	0.40 (± 0.34)	0.55 (± 0.26)	0.82 (± 0.08)	0.52 (± 0.34)	.111
RNLI	56.6 (± 24.5)	53.6 (± 24.4)	55.2 (± 21.3)	62.5 (± 25.7)	83.6 (± 1.3)	67.7 (± 25.3)	.217
PLUS-M (t-score) (n=43)	38.9 (± 11.9)	34.6 (± 10.8)	37.7 (± 12.2)	40.4 (± 10.7)	55.2 (± 4.5)	42.3 (± 13.5)	.164
Limb Fitted	84.0% (42)	82.4% (14)	81.8% (9)	100.0% (10)	50.0% (2)	100.0% (8)	.341

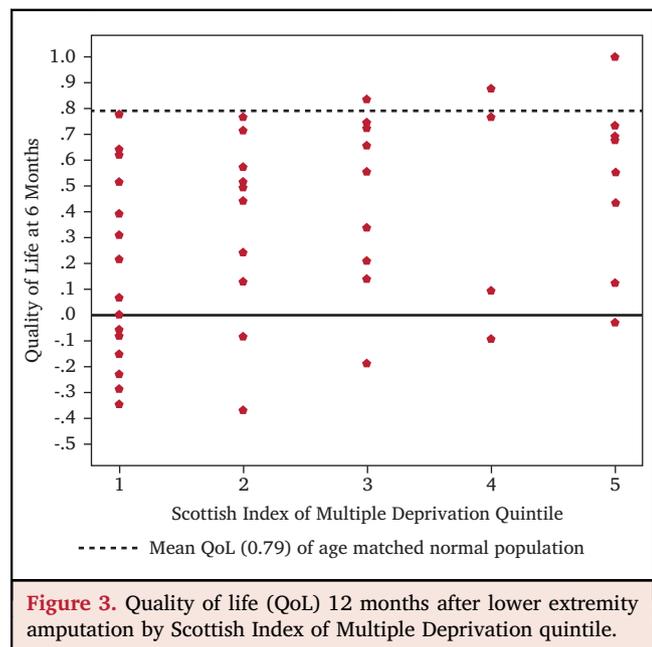
Data are n (%) unless otherwise indicated. LEA = lower extremity amputation; SIMD = Scottish Index of Multiple Deprivation; RNLI = Reintegration to Normal Living Index; PLUS-M = Prosthetic Limb User Survey of Mobility; EQ-5D-5L = postal questionnaires on quality of life (QoL).

* Statistically significant result.



with those in SIMD 5 having their LEA 13 years later than those in SIMD 1. Arya *et al.* demonstrated that there is a higher risk of amputation at a younger age when living in a lower socio-economic area.⁶ Furthermore, Tunstall-Pedoe *et al.* reported that living in the most deprived areas is associated with a significant increase in cardiovascular risk, an effect equivalent to increasing a person’s age by 10 years or attributing them with a diagnosis of diabetes.¹⁹

In addition to morbidity, mortality is also affected by SES as those in less deprived areas of GG&CHB live up to 15 years longer than those in more deprived areas.²⁰ Despite the high mortality rates at six and 12 months, this cohort study did not find any association between SES and mortality after a LEA. However, the difference in age across the



socio-economic groups is an important observation, as those who lived in SIMD 5 were 13 years older than those in SIMD 1, as age is an important predictor of mortality.

Approximately half (50%) of this cohort achieved prosthetic fitting, which is higher than figures of 40% reported by the Scottish Physiotherapy Amputee Research Group for the wider Scottish population (Scott *et al.*, 2015),²¹ 36% reported in an elderly USA population,²² and 45% reported in an elderly population of vascular patients in Australia.²³ The numbers in this study are too small to explore a link between deprivation and limb fitting, but this finding may be reflective of the higher number of people with proximal amputations (TFA) in the SIMD 1 cohort, perhaps indicating more advanced PAOD, rather than being a function of SES per se.

Although not statistically significant, the self reported mobility with the prosthesis (PLUS-M) at six and 12 months was poor (mean score 39.1 at six months and 38.9 at 12 months from maximum score of 71.4). Furthermore, levels of mobility were lowest in those from the most deprived area (PLUS-M scores in SIMD 1: 37.4 and 34.6 at six and 12 months, respectively), although this was not statistically significant ($p = .628$ and $p = .164$, respectively). A clear reason for the poor levels of mobility is the greater number of people in the lower socio-economic groups with TFA. It is more difficult to walk with a TFA prosthesis owing to increased energy requirements and as such this leads to greater dependence on walking aids.²⁴ There are no other published data describing prosthetic mobility over a longer duration or prosthetic mobility across socio-economic data zones and, as such, these are novel findings.

QoL was poor overall following LEA, compared with the general population, and particularly so for those from areas of greatest socio-economic deprivation, as many reported QoL as “worse than death”. The negative impact of a LEA on QoL has been discussed in several studies through cross sectional analysis of cohorts of patients, often with LEAs for mixed aetiologies.^{25,26} Although many studies report poor QoL after LEA, none has described the impact of SES.

A recent literature review found that the ability to participate in daily life while using a prosthesis was the most important factor influencing QoL following LEA.⁸ If more people were successfully limb fitted, this may facilitate greater participation and better QoL. Previous research has also reported a positive association between mobility and QoL, in prosthetic users of mixed aetiology.^{27,28} Deans *et al.* concluded that social integration was more important than physical capability in improving QoL in prosthetic users.²⁸ This may explain the poor RNLI scores in this study. A high proportion of those in the SIMD 1 cohort did not receive a prosthesis, rendering them wheelchair dependent and thus reducing their ability to participate socially, therefore negatively impacting their QoL. This is despite similar accessibility issues, within the home environment, being observed across all SIMD quintiles.

Seventy patients were unable to consent to completing questionnaires at the six month follow up owing to cognitive deficits and poor health; however, 34 of those who had

consented to participate in the six month follow up did not complete the questionnaires, of whom 10 had died. It is possible that those who completed the questionnaires represented “healthier” patients and the QoL of those who declined or were unfit to participate may have been substantially worse than those who did complete them. One of the limitations of the study was that QoL was not assessed immediately pre- or post-LEA. This limitation was unavoidable in this cohort as many were unwell prior to surgery or had their LEA as emergency procedures. Even if it had been assessed, at this point it would have been unlikely to represent the participants general QoL. Furthermore, the QoL measure is only pertinent to the person once they are discharged from the hospital setting. It is also worth noting that although the data are derived from a single Health Board, NHS GG&CHB is the largest in the UK and has an uneven distribution of its population across the SIMD quintiles, which is reflected in this cohort. The statistical analysis of this study was impeded owing to small numbers in each SIMD area, which declined over the course of the study. While the majority of the significant differences were seen when comparing SIMD 1 and 5, there is an acknowledgement that SIMD 5 was small ($n = 19$) and the participants were older than those in SIMD 1. Therefore, comparisons are of limited validity. In order to make statistically sound inferences from this observational study multivariable analysis would be required. Multiple confounders may exist that could potentially contribute to the low QoL, for example other comorbidities and social support networks; however, these data were not available within this study design.

Despite previous research into the prevalence of LEAs and increased mortality following LEA in people from more deprived areas, this is the first prospective longitudinal study to report that the majority of those with a LEA live in the most socially deprived areas. Furthermore, it is the first study that has shown that QoL is so poor after LEA, especially in people from the most socially deprived areas.

Improving QoL for people following LEA requires action not only from health services (including vascular surgeons and rehabilitation services), but also a wider societal response. There may be an assumption that improved mobility will lead to better QoL through increased exercise potential and better social integration. This would require significant investment by both health and social services. Justifying these costs would require a larger cohort study that could validate whether QoL was associated with SES. Such a study should allow for adjustment for confounding variables. Once this has been conducted, robust trials to see whether increased input during rehabilitation and better, more accessible housing will lead to better mobility and improved QoL, are required. Legislation integrating health and social care in Scotland was implemented in April 2016, after the 12 month follow up in this cohort,²⁹ so it may be that the situation in Scotland is changing, and that those living in more deprived areas may receive more targeted rehabilitation to improve their mobility after LEA.

CONFLICT OF INTEREST

None.

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