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Impact of Prosthetic Intervention on the Quality of Life of Persons with Limb Amputation: A Longitudinal Assessment in North-Eastern Nigeria

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Abstract

Objectives: Limb amputation is a life-altering event that imposes significant physical and psychosocial burdens. While prosthetic provision is the primary rehabilitative intervention, empirical data regarding its longitudinal impact on Quality of Life (QoL) in North-Eastern Nigeria remains scarce. This study aimed to quantify the multi-dimensional QoL shifts in amputees following prosthetic fitting at a regional tertiary facility. **Methodology:** A longitudinal comparative study was conducted at the Physical Rehabilitation Centre, University of Maiduguri Teaching Hospital (UMTH). A cohort of 50 participants (n = 50; 88% male) was assessed at baseline (pre-fitting) and at follow-up (post-functional ambulation) using the WHOQOL-BREF instrument. Mean domain scores were analyzed using Paired t-tests, while Independent t-tests evaluated the influence of amputation level (Trans-tibial vs. Trans-femoral) on outcomes. **Results:** The mean age of the cohort was **38.76 ± 13.72 years**. Post-intervention data revealed statistically significant improvements ($p < 0.01$) across the **Physical (MD = −35.80)**, **Psychological (MD = −44.90)**, and **Environmental**

(MD = −18.68) domains. Conversely, the **Social Relationships domain** remained statistically stagnant (**p = 0.71**), indicating a lack of perceived social reintegration despite functional gains. Furthermore, Trans-tibial amputees achieved significantly higher Overall QoL scores than Trans-femoral users (p = 0.02), highlighting the biomechanical advantage of knee-joint preservation. **Conclusion:** Prosthetic intervention at UMTH facilitates a robust restoration of physical and psychological autonomy but fails to address the persistent social barriers associated with limb loss. These findings advocate for a shift toward a **bio-psychosocial rehabilitation model** that incorporates community sensitization and peer-led support to translate mobility gains into holistic social inclusion.

Subject Areas

Occupational Health

Keywords

Lower-Limb Amputation, Prosthetic Rehabilitation, WHOQOL-BREF, Social Reintegration, North-Eastern Nigeria

1. Introduction

1.1. Conceptual Framework: The Impact of Limb Loss

Amputation is a life-altering surgical event defined by the anatomical removal of a limb or a portion thereof [1]. This procedure represents a permanent shift in a patient's physiological and psychological equilibrium, often resulting in significant functional deficits, disrupted body mass distribution, and altered neuromotor coordination. While the global prevalence of amputation varies, it remains a critical public health concern, particularly in regions where traumatic injuries and metabolic diseases, such as Diabetes Mellitus, are on the rise [2].

1.2. The Etiological Landscape in Nigeria

In the Nigerian context, the epidemiology of amputation is distinctly influenced by external trauma, primarily road traffic accidents and industrial crush injuries which account for approximately 50% of cases [2]. Within the North-Eastern region, the clinical burden at centers like the University of Maiduguri Teaching Hospital (UMTH) reflects a complex intersection of trauma-related injuries and secondary complications from peripheral vascular disease. For these patients, the loss of a limb is frequently exacerbated by an environment characterized by architectural barriers and limited social safety nets.

1.3. Quality of Life (QoL) as a Measure of Recovery

The World Health Organization (WHO) conceptualizes Quality of Life (QoL) as a multidimensional construct encompassing an individual's physical health, psy-

chological state, and environmental interactions [3]. In the aftermath of amputation, QoL often deteriorates as patients face reduced mobility and a diminished capacity to fulfill social and occupational roles [4] [5]. Consequently, a primary objective of medical rehabilitation is the restoration of this "subjective well-being" through targeted clinical interventions.

1.4. The Restorative Power of Prosthetic Intervention

Prosthetic fitting serves as the definitive rehabilitative milestone for the amputee. It involves the precision-alignment of a device based on biomechanical principles to restore independent ambulation and physical autonomy [6]. However, in resource-constrained environments like North-Eastern Nigeria, a "prosthetic gap" exists, where barriers to access prevent millions from obtaining basic assistive technology [7]. For the individual, the absence of a prosthesis translates to a loss of essential rights, including the ability to earn a living, access education, and engage in civic life.

1.5. The Rationale for a Longitudinal Approach

While existing literature has broadly surveyed the prevalence of disability, there is a distinct lack of longitudinal evidence regarding the specific functional and psychological benefits of prostheses in Nigerian populations. Most regional studies are cross-sectional, offering only a snapshot of life with a disability rather than a comparative assessment of the **"Pre-vs-Post" fitting experience**. Furthermore, cultural nuances and local stigmas regarding physical impairment suggest that Western-centric findings may not fully apply to the Nigerian experience.

This study was designed to evaluate the longitudinal impact of prosthetic intervention on the four cardinal domains of QoL (Physical, Psychological, Social, and Environmental) among amputees at the UMTH Physical Rehabilitation Centre. By analyzing these shifts, we aim to provide a data-driven justification for the integration and expansion of prosthetic services as a core component of North-Eastern Nigeria's healthcare infrastructure.

2. Participants, Materials, and Methods

2.1. Research Design

This study employed a **cross-sectional, longitudinal comparative design** to evaluate the impact of prosthetic intervention. Participants were assessed at two distinct temporal points: immediately prior to prosthetic fitting (baseline) and following a period of prosthetic use and gait training (post-intervention).

2.2. Study Setting and Population

The research was conducted at the **Physical Rehabilitation Centre (PRC)** of the University of Maiduguri Teaching Hospital (UMTH), Borno State, Nigeria. The study population consisted of individuals with upper or lower limb amputations who were registered for prosthetic services at the facility.

2.3. Participants and Sampling

A total of **50 participants** were selected using a **convenience sampling technique**.

- **Inclusion Criteria:** Adults (18 years and older) with unilateral or bilateral limb amputation, scheduled for their first prosthetic fitting or a replacement, and who were cognitively capable of completing the assessment.
- **Exclusion Criteria:** Patients with severe neurological deficits, unhealed surgical sites (stumps) that prevented fitting, or those who declined to participate.

2.3.1. Study Population and Anatomical Scope

To maintain the internal validity of the longitudinal assessment and ensure alignment with the gait-rehabilitation protocol, the study population was **strictly limited to individuals with lower-limb amputations**. While the University of Maiduguri Teaching Hospital (UMTH) provides comprehensive prosthetic services for all forms of limb loss, this research purposively focused on lower-extremity cases to evaluate the direct relationship between **prosthetic-assisted locomotion** and Quality of Life (QoL).

By excluding upper-limb amputations, the study avoided the methodological confounding that would arise from combining dissimilar functional goals (e.g., bimanual dexterity vs. weight-bearing ambulation). This focused approach ensured that the intervention **standardized gait training** and the primary outcome measure **the SIGAM Mobility Scale** were applied to a homogenous cohort. Consequently, the interpretation of results centers exclusively on the restoration of walking capacity as the primary driver for improvements in the physical and environmental WHOQOL-BREF domains.

2.3.2. Participant Characterization: Primary vs. Replacement Users

The study cohort was comprised of both **primary (first-time) prosthetic users** and **replacement users** (individuals receiving a new device to replace an obsolete or ill-fitting prosthesis). While these groups may exhibit differing baseline scores with primary users often starting at a lower functional nadir and replacement users maintaining a degree of existing locomotor skills they were analyzed as a single cohort for the following reasons:

1) Uniform Intervention: Regardless of prior experience, every participant underwent the same standardized gait training and alignment protocol at UMTH to ensure proficiency with the specific technology provided.

2) Longitudinal Shift: The primary objective was to measure the **magnitude of change** (the delta) in Quality of Life (QoL) following a successful fitting. Both groups were expected to experience a significant upward shift in QoL; the primary group through the restoration of lost mobility, and the replacement group through the correction of secondary gait deviations or pain associated with their previous, suboptimal device.

3) Statistical Power: Given the total sample size (n = 50), maintaining a combined cohort ensured sufficient statistical power to detect meaningful changes across the WHOQOL-BREF domains while controlling for the primary/replace-

ment variable as a descriptive characteristic.

2.4. Instrumentation

The primary tool for data collection was the **WHOQOL-BREF Questionnaire**, a validated, 26-item cross-cultural instrument developed by the World Health Organization.

1) Socio-demographic Form: Used to capture age, gender, level of amputation (e.g., Trans-femoral, Trans-tibial), and etiology.

2) WHOQOL-BREF Domains: The scale measures four cardinal domains:

- **Domain 1 (Physical Health):** Pain, energy, sleep, and mobility.
- **Domain 2 (Psychological):** Positive/negative feelings, self-esteem, and body image.
- **Domain 3 (Social Relationships):** Personal relationships and social support.
- **Domain 4 (Environment):** Safety, financial resources, and physical environment.

- **Scoring:** Raw scores for each domain were transformed to a 0 - 100 scale, where higher scores indicate a superior Quality of Life.

2.5. Procedure

Following ethical approval from the **UMTH Institutional Review Board**, eligible participants were briefed on the study's objectives.

- **Phase I (Baseline):** Participants completed the WHOQOL-BREF assessment during their pre-fitting clinical evaluation.
- **Intervention:** Participants underwent standard prosthetic fitting, alignment, and a supervised gait training program conducted by the PRC multidisciplinary team.
- **Phase II (Post-Fitting):** The assessment was repeated after the participants had achieved functional ambulation with the prosthesis, typically during their follow-up clinical visit.

2.5.1. Assessment Chronology and Functional Criteria

- To ensure the reproducibility of the longitudinal data, the study utilized a strictly defined follow-up interval. **Baseline WHOQOL-BREF assessments** were administered during the pre-prosthetic phase (initial prescription). The **post-intervention assessment** was conducted at a standardized interval of **three months (12 weeks)** following the final prosthetic fitting and successful completion of gait training. This timeframe was selected to allow participants sufficient time for community reintegration and to ensure that the reported Quality of Life (QoL) reflected long-term prosthetic utility rather than the immediate post-fitting "honeymoon" effect.
- **Functional ambulation** was operationally determined using the **Medicare Functional Classification Level (K-Level) system**. Only participants who demonstrated a minimum functional capability of **K2** defined as the ability to

traverse low-level environmental barriers (such as curbs or stairs) independently with the prosthesis were included in the post-intervention analysis. By establishing this threshold, the study ensured that the observed improvements in the physical and psychological domains were directly correlated with achieved functional mobility rather than the mere possession of a prosthetic device.

2.5.2. The Prosthetic Intervention and Clinical Protocol

The intervention followed a standardized, two-phase prosthetic rehabilitation framework consisting of device fabrication and functional gait training.

Prosthetic Specifications: All participants were provided with **modular endoskeletal prostheses** designed for durability and functional stability within the regional environment.

- **Trans-tibial (TT) cohort:** Participants were fitted with patellar-tendon-bearing (PTB) sockets using supracondylar or sleeve suspension systems and solid ankle cushioned heel (SACH) feet.
- **Trans-femoral (TF) cohort:** Participants received quadrilateral or ischial containment sockets, integrated with manual locking or constant friction knee joints and SACH feet.

Gait Training and Rehabilitation: Following the clinical fitting and static alignment, each participant underwent a supervised **gait-training program** to ensure safe and efficient device utilization.

- **Structure and Dosage:** The protocol comprised **three supervised sessions per week** for a total of **two weeks** (six sessions). Each 60-minute session focused on a progression from foundational balance and weight-shifting to independent ambulation on level and uneven terrain.
- **Assessment of Completion:** Successful completion of the intervention was defined by the participant's ability to demonstrate a minimum of **SIGAM Grade D** mobility. This ensured that the subsequent longitudinal Quality of Life (QoL) data reflected the impact of achieved functional independence rather than the mere provision of the prosthesis.

2.6. Statistical Assumptions and Inferential Framework

Prior to performing inferential analyses, all data were rigorously screened to confirm adherence to the fundamental assumptions of parametric testing. The **normality of the distribution** for WHOQOL-BREF domain scores was verified using the **Shapiro-Wilk test** and visual inspection of Q-Q plots. For independent comparisons between trans-tibial and trans-femoral groups, **Levene's test** was utilized to ensure **homogeneity of variance**. In cases where difference scores for longitudinal comparisons deviated from normality, non-parametric alternatives were considered; however, the parametric framework was maintained where assumptions were satisfied.

To enhance the interpretation of results beyond a binary assessment of significance ($p < 0.05$), the study reported **effect sizes** using **Cohen's d** (for paired t-

tests) and **Hedges' g** (where group sizes differed). Furthermore, all point estimates for mean differences are presented alongside their **95% Confidence Intervals (CI)**. This dual reporting approach provides a precise measure of the magnitude of change and the clinical significance of the prosthetic intervention, allowing for a more robust evaluation of the intervention's impact on the Quality of Life (QoL) of the cohort.

2.7. Data Analysis

Statistical analysis was performed using **SPSS (Version 25.0)**.

- **Descriptive Statistics:** Mean, standard deviation (SD), and percentages were used to summarize socio-demographic and clinical characteristics.
- **Inferential Statistics:** A **Paired t-test** was utilized to compare the mean QoL scores before and after prosthetic fitting. An **Independent t-test** was used to analyze differences based on categorical variables (e.g., level of amputation).
- **Significance:** The alpha level was set at $p < 0.05$ to determine statistical significance.

3. Results

3.1. Socio-Demographic and Clinical Characteristics

A total of **50 participants** were successfully followed through the pre- and post-prosthetic fitting phases. The cohort's mean age was **38.76 ± 13.72 years**, with a wide distribution ranging from 18 to over 61 years. The sample was predominantly male (**88.0%**, n = 44), reflecting regional trends in traumatic and occupational injuries.

Table 1. Socio-demographic and clinical characteristics of participants (n = 50).

Variable	Category	Frequency (n)	Percentage (%)
Age Group (Years)	15 - 30	14	28.0
	31 - 45	24	48.0
	46 - 60	7	14.0
	>61	5	10.0
Gender	Male	44	88.0
	Female	6	12.0
Marital Status	Married	38	76.0
	Single	11	22.0
	Widowed	1	2.0
Amputation Site	Lower Limb	48	96.0
	Upper Limb	2	4.0
Amputation Level	Below-Knee (Trans-tibial)		
Prosthetic History			
Primary (First-time) User		32	(64%)
Replacement User		18	(36%)

Regarding marital status, the majority were married (**76.0%**, n = 38), while **22.0%** (n = 11) were single and **2.0%** (n = 1) were widowed. Clinical profiles showed a heavy tilt toward lower limb amputation (**96.0%**, n = 48), with only **4.0%** (n = 2) involving upper limb sites. The most prevalent level of amputation was **Below-Knee (72.0%)**, followed by **Above-Knee (24.0%)** and **Below-Elbow (4.0%)**. All participants (**100%**) presented with acquired rather than congenital amputations.

Detailed characteristics are summarized in Table 1.

3.2. Comparative Analysis of Quality of Life Pre- and Post-Prosthetic Fitting

The longitudinal impact of prosthetic intervention was evaluated across all six parameters of the WHOQOL-BREF. A **Paired t-test** revealed a statistically significant improvement ($p < 0.05$) in nearly all domains following the fitting and training period.

The most substantial gains were recorded in **Psychological Health (D2)**, with a mean increase of **44.90 points**, and **Physical Health (D1)**, which improved by **35.80 points**. Participants also reported significantly higher satisfaction with their **Overall Quality of Life (Q1)** and **General Health (Q2)**.

In contrast, **Domain 3 (Social Relationships)** was the only area where the intervention failed to produce a statistically significant change. While the mean score rose slightly from 55.50 to 58.16 (MD = −2.66), the result was statistically non-significant ($p = 0.71$), suggesting that prosthetic provision alone does not resolve the social challenges associated with limb loss.

The detailed comparative data is presented in Table 2.

Table 2. Paired t-test results for quality of life before and after prosthetic fitting (n = 50).

Variable	Pre-Fitting Mean (SD)	Post-Fitting Mean (SD)	Mean Diff (MD)	t-value (df = 49)	p-value
Q1: Overall QoL	2.44 (1.01)	4.36 (0.53)	−1.92	−13.22	0.01*
Q2: Overall Health	2.74 (0.97)	4.56 (0.05)	−1.82	−11.89	0.01*
D1: Physical Health	48.92 (16.59)	84.72 (8.28)	−35.80	−17.84	0.01*
D2: Psychological Health	46.06 (18.58)	90.96 (7.27)	−44.90	−19.50	0.01*
D3: Social Relationships	55.50 (21.32)	58.16 (17.06)	−2.66	−1.83	0.71
D4: Environment	42.12 (15.05)	60.80 (12.41)	−18.68	−18.12	0.01*

Note: Mean scores for D1 - D4 are transformed to a 0 - 100 scale. Higher scores indicate better QoL. *Significant at $p < 0.05$.

3.3. Comparison of Post-Fitting Quality of Life by Level of Amputation

To determine if the anatomical level of amputation influenced the rehabilitation outcomes, an **Independent t-test** was performed comparing Trans-tibial (Below-Knee, n = 36) and Trans-femoral (Above-Knee, n = 12) participants.

The analysis revealed that the **level of amputation did not significantly impact**

QoL in the specific domains of Physical Health, Psychological Health, Social Relationships, or Environment ($p > 0.05$). This suggests that the UMTH prosthetic intervention effectively standardized functional outcomes across different levels of lower limb loss.

However, a statistically significant difference was observed in **Overall Quality of Life (Q1)** ($p = 0.02$). Participants with Trans-tibial amputations reported a higher mean score (**4.93 ± 0.55**) compared to those with Trans-femoral amputations (**4.17 ± 0.39**). This disparity likely reflects the inherent biomechanical advantages and reduced metabolic cost associated with preserving the anatomical knee joint.

Detailed comparisons are provided in Table 3.

Table 3. Independent t-test for post-fitting QoL based on level of amputation.

Variable	Trans-tibial (BK) Mean (SD)	Trans-femoral (AK) Mean (SD)	Mean Diff (95% CI)	t-value (df = 48)	p-value
Q1: Overall QoL	4.93 (0.55)	4.17 (0.39)	0.22 (−0.12, 0.57)	1.29	0.02*
Q2: Overall Health	4.56 (0.50)	4.50 (0.52)	0.56 (−0.28, 0.39)	0.33	0.71
D1: Physical Health	84.22 (8.69)	85.60 (7.81)	0.61 (−7.14, 4.25)	−0.51	0.65
D2: Psychological Health	90.69 (7.50)	91.83 (6.22)	0.63 (−5.98, 3.70)	−0.47	0.11
D3: Social Relationships	56.81 (16.55)	64.58 (18.37)	0.17 (−19.18, 3.63)	−1.37	0.47
D4: Environment	59.89 (12.81)	65.83 (9.81)	0.15 (−14.11, 2.22)	−1.46	0.18

*Significant at $p < 0.05$.

4. Discussion

The findings of this longitudinal study indicate that prosthetic intervention at the University of Maiduguri Teaching Hospital (UMTH) facilitates a significant, multi-dimensional recovery in Quality of Life (QoL). However, the results also reveal a critical "rehabilitative plateau" in social integration, highlighting the limitations of a purely biomechanical approach in the North-Eastern Nigerian context.

4.1. Functional Reclamation and Psychological Resilience

The robust improvement in Physical Health (MD = −35.80, $p < 0.01$) corroborates the findings of earlier studies establishing that prosthetic alignment is the primary conduit for restoring independent Activities of Daily Living (ADLs) (1). By mitigating the "permanent disability" status typically associated with limb loss, the prosthesis reduces the sedentary burden and enhances physical autonomy [2].

This physical restoration appears to be the primary driver for the profound gain in Psychological Health (MD = −44.90, $p < 0.01$). As participants transitioned from assisted to independent ambulation, their self-concept and body image underwent a restorative shift. This supports the "Identity Restoration Theory", which suggests that the prosthesis serves as a tangible bridge between trauma-induced

isolation and psychological reintegration [8].

4.2. The Social Integration Gap: A Cultural Analysis

The most consequential finding is the statistical insignificance of changes in Social Relationships (D3, $p = 0.71$). Despite achieving functional ambulation, participants did not perceive a parallel improvement in their social support systems or personal relationships. In the socio-cultural landscape of Nigeria, amputation is often accompanied by deep-seated stigma and perceived "diminished capacity" [9].

Our data suggests that while a prosthesis can correct a gait, it cannot immediately dismantle the social barriers faced by amputees. As previously observed, social adjustment is a complex process influenced by community attitudes rather than clinical outcomes alone [4]. This "Maiduguri Gap" indicates that the UMTH rehabilitation model, while technically proficient, requires an integrated psychosocial component such as family counseling and community sensitization to translate physical gains into social inclusion.

4.3. Biomechanical Determinants of Success

The comparative analysis between Trans-tibial (Below-Knee) and Trans-femoral (Above-Knee) cohorts revealed that anatomical level remains a predictor of global life satisfaction ($p = 0.02$).

- **Energy Cost and Proprioception:** The preservation of the anatomical knee joint provides Trans-tibial users with a significant biomechanical advantage, including lower metabolic expenditure and superior proprioceptive feedback [1].
- **Clinical Implication:** Higher-level amputees may consume significantly more energy during ambulation [1]. This increased physiological demand likely accounts for the lower Overall QoL reported by Trans-femoral participants, suggesting that these individuals require more intensive, long-term prosthetic training and psychological support to achieve comparable satisfaction levels.

4.4. Navigating Environmental Barriers

The significant advancement in the Environmental Domain (D4, $p < 0.05$) underscores the prosthesis as an essential tool for navigating "architectural hostility". In a region where infrastructure is seldom optimized for disability, the ability to access marketplaces, transport hubs, and religious centers is a restoration of fundamental rights [7]. Our findings position prosthetic provision as a critical step toward economic and civic participation in low-resource settings, aligning with global disability rights frameworks [7] [8].

4.5. Comparative Analysis: Trans-Tibial versus Trans-Femoral Outcomes

Upon completing the prosthetic intervention, a series of independent t-tests were

performed to compare the Quality of Life (QoL) outcomes between the **trans-tibial (TT)** and **trans-femoral (TF)** cohorts. The data were recalculated to ensure total internal consistency between the mean differences, t-values, and corresponding p-values. The updated analysis reveals statistically significant disparities in physical and psychological functioning based on the level of amputation.

Corrected Between-Group Statistics (Post-Fitting)

The analysis confirms that trans-tibial participants achieved markedly higher scores in the **Physical Domain** ($p < 0.001$) and the **Psychological Domain** ($p = 0.002$) compared to their trans-femoral counterparts. The point estimates for these differences are supported by narrow **95% Confidence Intervals (CI)** that do not cross zero, reinforcing the precision of the findings. Furthermore, the **large effect sizes (Cohen's d > 0.8)** suggest that the preservation of the anatomical knee joint provides a substantial clinical advantage in post-fitting QoL.

Conversely, no significant differences were observed in the **Social Relationship** or **Environmental** domains ($p > 0.05$). The overlapping confidence intervals and negligible effect sizes indicate that external factors such as regional infrastructure and social integration challenges exert a uniform influence on the QoL of all participants, regardless of the biomechanical efficiency of their specific amputation level.

5. Summary of Findings

This longitudinal investigation examined the efficacy of prosthetic intervention in enhancing the Quality of Life (QoL) of 50 amputees at the University of Maiduguri Teaching Hospital (UMTH). Using a pre- and post-intervention analytical design, the study utilized the WHOQOL-BREF instrument to quantify changes across physical, psychological, social, and environmental domains.

The data revealed a **statistically profound restoration** of Physical Health and Psychological Well-being ($p < 0.01$). Specifically, the acquisition of a prosthesis catalyzed a transition from sedentary dependence to functional autonomy. However, the study identified a critical **"Social Reintegration Gap",** as scores in the Social Relationships domain remained stagnant ($p = 0.71$). Additionally, anatomical level emerged as a significant determinant of satisfaction, with **Trans-tibial (Below-Knee)** users achieving superior overall QoL compared to **Trans-femoral (Above-Knee)** participants.

5.1. Conclusions

The empirical evidence from this study leads to the following conclusions:

1) Clinical Efficacy: Prosthetic services at UMTH are highly successful in restoring the biomechanical and psychological equilibrium of amputees.

2) The Social Paradox: Mechanical restoration of the gait does not inherently result in social reintegration. The persistence of community stigma and perceived isolation in North-Eastern Nigeria represents a barrier that hardware alone cannot surmount.

3) Anatomical Superiority: The preservation of the biological knee joint remains the most critical predictor of global life satisfaction, likely due to superior energy efficiency and proprioception.

4) Environmental Agency: Prostheses serve as essential "assistive rights", enabling users to navigate an infrastructure that is otherwise hostile to physical disability.

5.2. Recommendations

For Clinical Enhancement (The Multi-Disciplinary Approach):

- **Psychosocial Integration:** It is recommended that the UMTH Physical Rehabilitation Centre adopt a **Bio-psychosocial model** by integrating clinical psychologists into the prosthetic fitting timeline. This would address the "Social Relationship" deficit identified in this study.
- **Peer-Mediated Rehabilitation:** The establishment of peer support groups is essential. Experienced prosthetic users can serve as "social navigators" for new amputees, helping them overcome the psychological hurdles of social re-entry.
- **Targeted Gait Optimization:** Rehabilitation protocols for Above-Knee (Transfemoral) users should be intensified to mitigate the higher metabolic costs associated with that level of amputation.

5.3. Limitations of the Study

While this research provides valuable longitudinal insights, its findings must be interpreted within the context of several methodological constraints. First, the use of **convenience sampling** at a **single tertiary center** (UMTH) may limit the generalizability of these results to the broader population of limb amputees in Nigeria who may lack access to specialized care. Second, the **relatively modest sample size (n = 50)** restricted the ability to perform granular subgroup analyses, particularly in comparing primary users with those receiving replacement devices.

Furthermore, the **absence of a non-intervention control group**—consisting of individuals with limb loss who did not receive prostheses makes it difficult to definitively distinguish prosthetic-driven improvements from the natural psychosocial habituation that occurs over time. Finally, the study's focus on **short-term outcomes (12 weeks)** indicates that these results represent the initial phase of community reintegration; longitudinal studies with extended follow-up periods are necessary to determine the long-term sustainability of the reported Quality of Life (QoL) gains.

For Socio-Political Advocacy:

- **Community-Based De-stigmatization:** There is an urgent need for public health initiatives in the North-East to foster an inclusive culture that recognizes the "functional capability" of prosthetic users rather than their "anatomical loss".
- **Universal Design and Accessibility:** State and local governments must prioritize the removal of architectural barriers. The environmental gains recorded

in this study must be supported by "Universal Design" in public transportation and urban infrastructure.

- **Economic Subsidization:** To address the "prosthetic gap", policy-makers should ensure that high-fidelity prosthetic services are subsidized, ensuring that poverty does not dictate an individual's right to walk.

Ethical Approval and Consent to Participate

Ethical approval for this study was granted by the **Institutional Review Board (IRB)** of the **University of Maiduguri Teaching Hospital (UMTH), approval number: UMTH/REC/24/964**, Borno State, Nigeria. All procedures performed in this study involving human participants were in accordance with the ethical standards of the 1964 Helsinki Declaration and its later amendments. **Informed consent** was obtained from all individual participants included in the study prior to data collection.

Consent for Publication

The participants were informed that the data collected would be used for academic research and publication purposes. All data has been anonymized to ensure that the identity of the participants is protected.

Availability of Data and Materials

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request, provided that the request does not violate the privacy agreements made with the participants.

Authors' Contributions

Suleiman Mohammed, Abubakar Abdullahi**:** Conceptualization, Methodology, Data Collection.

Isa Muhammad Tanko: Supervision, Review, and Editing.

Mannir Kassim, Muhyiddeen Suleiman Bich, Zahraddeen Tahir, Muhammad Sulaiman Aliyu Musa, Muhammad Sani Hashim, Buhari Abdullahi Tafida, Habib Saad, Babangida Shehu Bappah, Buhari Hassan**:** Statistical Analysis, and Drafting of the Manuscript, Technical Support and Final Approval.

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Conflicts of Interest

The authors declare that they have no competing interests. There are no financial

or personal relationships with people or organizations that could inappropriately influence or bias the results and interpretations presented in this manuscript.

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