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Physical and Cardiorespiratory Functioning of Patients with Unilateral Lower Limb Amputation in Sri Lanka

By

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"PHYSICAL AND CARDIORESPIRATORY FUNCTIONING OF PATIENTS WITH UNILATERAL LOWER LIMB AMPUTATION IN SRI LANKA"

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LIST OF ACRONYMS

6MWD	:	Six Minute Walk Distance
6MWT	:	Six Minute Walk Test
AMP	:	Amputee Mobility Predictor
AMPPRO	:	Amputee Mobility Predictor with Prosthesis
ANOVA	:	Analysis of Variance
ATS	:	American Thoracic Society
BMI	:	Body Mass Index
BP	:	Blood Pressure
CHAMP	:	Comprehensive High-Activity Mobility Predictor
CI	:	Confidence Interval
CRP	:	Centre for Rehabilitation of Paralysis
DASH	:	Disabilities of the Arm, Shoulder and Hand
DM	:	Diabetes Mellitus
FEV1	:	Forced Expiratory Volume within 1st second
FVC	:	Forced Vital Capacity
EHR	:	End Heart Rate
RHR	:	Resting Hart Rate
ICF	:	International Classification of Functioning and Disability
LCI	:	Locomotor Capability Index
LLA	:	Lower Limb Amputation
MFCL	:	Medicare Functional Classification Level
NGOs’	:	Non-governmental Organizations
NHANES	:	National Health and Nutrition Examination Survey
PaO_2	:	Saturation Level
PEFR	:	Peaked Expiratory Flow Rate
PEQ	:	Prosthesis Evaluation Questionnaire
PLUS	:	Prosthetic Limb Users Survey
RR	:	Respiratory Rate
SD	:	Standard Deviation
SDG	:	Sustainable Development Goals

SEW	:	Symmetry in External Work
SHAP	:	Southampton Hand Assessment Procedure
TAPES	:	Trinity Amputation and Prosthesis Experience Scales
TUG	:	Timed Up and Go test
VO_2max	:	Maximum Oxygen Consumption
WHO	:	World Health Organization

ABSTRACT

Background: Government and non-governmental hospitals and organizations are distributing massive rehabilitation programs all over the Sri Lanka to rehabilitate the people with amputation. Nevertheless, there is no proper pathway to measure the effectiveness of those programs in terms of participation in daily life after rehabilitation. Therefore this study was conducted to find out functional outcomes of patients with unilateral lower limb amputation who engaged in rehabilitation and to explore impact of socio-demographics, amputation status, medical, and rehabilitation guidance on functional outcomes.

Methods: 48 unilateral lower limb amputees participated and were measured for functional outcomes using Locomotor Capabilities Index (LCI), Amputee Mobility Predictor with Prosthesis (AMPPRO), Six Minute Walk Test, VO_2max and Spirometry. Self-constructed questionnaire and qualitative interview was carried out to determine the socio-demographics, amputation status, medical, and rehabilitation process.

Results: Around 65% belongs to K3 and K4 level in AMPPRO classification and 96% of individuals have ability to perform basic daily activities without assistive devices, this reduced to 83% when engaged in advanced activities based on LCI. We found that 31% have a restrictive pattern of respiratory functions based on spirometry test, and 48% showed an unsatisfactory level of cardiovascular endurance based on VO_2max. The level of amputation, years since amputation, time gap between amputation and admission for rehabilitation, prostheis usage and prosthetic usage satisfaction, and mobility hours per day significantly impact ($p<0.005$ at 95% CI) on physical functioning. 6MWD scores significantly change ($p<0.005$ at 95% CI) in respect to AMPPRO K level, gender, age and level of amputation. Individuals with K4 level have significantly higher 6MWD and VO_2max values. From qualitative analysis appeared that government hospitals mainly focus on basic care after the amputation surgery but not on further advices or rehabilitation guidance. Rehabilitation services mainly focus on basic independence in daily life and basic walking training but not on long term survival, distance walking and cardiorespiratory endurance. Hence, this study recommending to arrange awareness programs to raise the awareness of the society about rehabilitation services and to medical and rehabilitation professionals in Sri Lanka to arrange their post-surgical and rehabilitation programs in an effective way, and government and responsible authorities to take further steps to fill-up gaps in rehabilitation services.

Key words: Unilateral lower limb amputation, Rehabilitation, Physical functioning, cardiorespiratory functions, basic care and rehabilitation guidance

Chapter I
INTRODUCTION

1.1. Background of Amputation

Amputation is surgically removal of full or part of the limbs to protect the other parts (Porter, 2003). Though some scholars says there are 3 to 44 per 100,000 amputees in Spain, Japan and India (Ubayawansa, 2016), According to the manual for the rehabilitation of people with limb amputation there is no true statistics about the number of amputees in the world (World Health Organization [WHO], 2004). Nevertheless, articles report that, there are about 160,000 amputees in Sri Lanka due to the 30 years civil war and there is no statistics on prevalence rate of amputees in Sri Lanka (Institution of Mechanical Engineers, 2014).

Peripheral vascular diseases, trauma, diabetes, congenital anomalies, sensory problems and loss of functions are the common incidences for amputation around the world (Porter, 2003). According to the findings, foot ulcers due to diabetics (37.6%), peripheral vascular diseases (31.7%), trauma, acute limb ischemia, infection, chronic osteomyelitis, elephantiasis, pressure sore and chronic wound are the indications for lower limb amputation in Sri Lanka (Ubayawansa, 2016).

According to the damage there are different levels of amputations and these levels are; through shoulder, above elbow, through elbow, below elbow, hand amputation, through hip, above knee, through knee, below knee and through ankle (Figure 1) (Porter, 2003). Limb amputation makes massive changes of homeostasis due to reduction of body mass, vascular system, static and dynamic functions. Rehabilitation and prosthetic fitting become more complicated as cardiovascular functions, metabolism, exercise tolerance and capacity declines (Kurdibaylo, 1994). Furthermore, major limb amputation affects on respiratory system and it reduces breathing capacity and maximum oxygen consumption (VO_2max) and increase the respiratory rate (RR) (Buckley & Buckley, 2016).

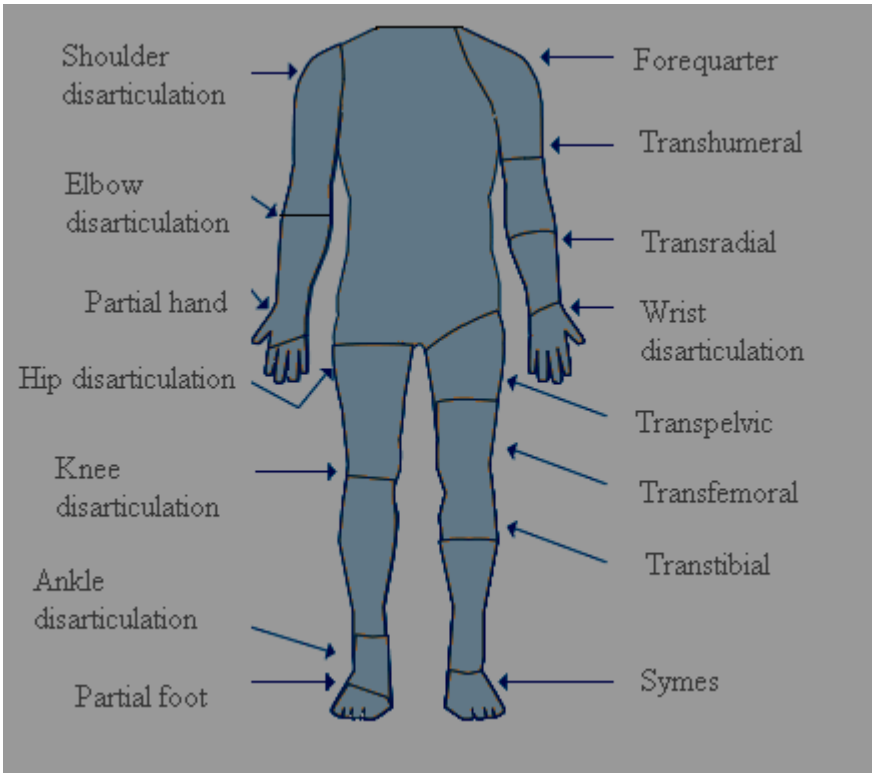


Figure 1.1. Levels of surgical amputation of human body
(Porter, 2003)

1.2. Rehabilitation of Amputation Patients

Rehabilitation of the patient is the key task after the amputation surgery and this rehabilitation is mainly focus on improving patients' general health and psychological level, reducing the pain, caring of stump and skin, fitting of the prosthesis, and helping amputation patients in regaining their functioning and activity participation (Porter, 2003). Restoration of functioning mainly consists of improving total physical functioning as well as improvement of cardiorespiratory functions (Simmelink, Wempe, Geertzen, Der, & Dekker, 2018).

According to World Health Organization (WHO) guideline, range of motion, strengthening and endurance exercises are the group of exercises which is given to improve the functional outcome of amputation patients at first stage. Bathing, dressing, feeding, toileting, hygiene, transferring, walking, going up and down stairs and hopping up a step are the main physical functioning outcomes which are expected in later stages of rehabilitation. In addition to that walking, jogging and stationary bike programs can be implemented to improve the cardiovascular as well as muscular

endurance (World Health Organization [WHO], 2004). Prosthetic fitting and achieving functional outcome with the prosthesis is the next step of rehabilitation which is subjected to the patient age, level of amputation, amputee limb and stump condition and cardiorespiratory functions (Kurdibaylo, 1994).

Amputation patients are more prone to have complications and comorbidities if they fail to receive proper rehabilitation. Particularly the patients with lower limb amputation (LLA) have greater risk of developing cardiovascular diseases due to reduction of physical fitness and VO_2max. Development of these diseases may further decline their walking ability with the time (Simmelink et al., 2018). Therefore rehabilitation programs for patients with amputation has to be addressed all the above factors to gain better outcome of the patients.

1.3. Assessment of Functional Outcomes of Patients with Amputation

Main focus of rehabilitation is to improve functional outcomes and quality of life as make them functionally independent and actively participate in the society (Agrawal, 2016). There are several scales that can be used in clinical settings to assess functional outcomes and quality of life. These scales basically can be divided in to three categories named self-reported measures or patient-reported outcomes, performance based measures and biomechanical measures which can use at the beginning, through out and at the end of the rehabilitation programme to assess patient achievements as well as improvements (Agrawal, 2016).

Self-reported measures or patient-reported outcomes can be assess through scales such as Amputee activity survey, Prosthesis evaluation questionnaire (PEQ), Prosthetic profile of the Amputee, Locomotor capabilities index, Orthotic prosthetic users' survey, Trinity amputation and prosthesis experience scales (TAPES), Prosthetic limb users survey (PLUS) and Disabilities of the arm, shoulder and hand (DASH) (Agrawal, 2016).

Performance based measures can be assess using scales such as Amputee mobility predictor (AMP), Comprehensive high-activity mobility predictor (CHAMP), Timed up and go test (TUG), Six minute walk test (6MWT) and Southampton hand assessment procedure (SHAP). Biomechanical measures can be assess using scales such as Symmetry in external work (SEW) measure (Agrawal, 2016).

1.4. Problem Justification

Government hospitals and institutes as well as non-governmental organizations (NGOs') are distributing massive rehabilitation programs all over the Sri Lanka to rehabilitate the people with amputation. Nevertheless, there is no proper pathway to measure the effectiveness of those programs in terms of participation in daily life after rehabilitation and its relationship with physical functioning and cardiorespiratory functions. Furthermore, there are no studies that explain "how do physical functioning impact on cardiorespiratory functions or vice versa". Therefore this study was conducted to find out physical functioning and cardiorespiratory functions of patients with unilateral lower limb amputation who engaged in rehabilitation. Further, to explore impact of socio-demographical, and amputation status and medical, and rehabilitation guidelines on physical functioning and cardiorespiratory functions. Based on the findings of this study, awareness programs will be arranged for the people with amputation and rehabilitation professionals to conduct their rehabilitation programs in an optimal way.

1.5. Research Question

- How the physical and cardiorespiratory functioning of patients with unilateral lower limb amputation are variating in relation to sociodemographic, amputation and rehabilitation characteristics?

Chapter II
LITERATURE REVIEW

A study was conducted to find out the cardiorespiratory functions and ability of doing functional movements of adults with amputations. Adults who fall age between 20 to 40 years with different level of upper and lower limb amputations (n=230) has taken as the study participants in order to find the cardiac and respiratory activity level. Traumatic patients with amputation who are not having prior respiratory or vascular disease have being selected as the eligibilities for the study and Functions were assessed at rest as well as after the wheel chair ergometer test. The study has found in changes of minute stroke volume, contractile capability of myocardium, sub maximal exercise training, work capacity and maximal oxygen consumption in amputation individuals rather than control group. Finally the study concludes that ability of moving is related with the level of amputation and limb condition like other factors. Furthermore, they have found that good condition of cardiorespiratory functions is a key factor to have quality amputee limb which is influence to increase the movement ability (Kurdibaylo, 1994).

Esfandiari et al. (2017) has studied about functions and long term symptoms of lower limb amputees in recreational camp in Iran, who affected due to war. Cross sectional study has conducted among 587 amputation people who have through hip, above knee and through knee amputation. Self-constructed questionnaire has filled based on the participants physical examination related to phantom sensation, phantom pain, pain in the stump, lower back pain and unaffected limb joint pain. Functional level has assessed using Amputee Mobility Predictor (AMP) with the prosthesis. The study reviewed that mean amputation duration as 22 years and percentages of common symptoms such as phantom sensation, lower back pain and phantom pain are 82%, 69% and 63% respectively. Addition to that they found mean AMP score as 20.8 and 28 among knee disarticulation and Trans-femoral amputees respectively. Finally the study has concluded that, lower limb amputation people suffered more with functional problems and the study suggested that these people require better rehabilitation programs to improve their wellbeing.

Mackenzie et al. (2004) has conducted a study to measure functional outcomes after lower limb amputation due to trauma. The aims of the study were to assess the

functional outcomes and compare with the level of amputation and find other factors related to the functional outcome. Cohort study has conducted using 161 patients who have above ankle amputation three months later and patients' functional level was examined every 3 months, 6 months, 12 months and 24 months of the study. The Sickness Impact Profile and a self-reported measure of functional status have used to assess the functional outcomes. Addition to that, pain, level of independency during transfer, walking, stair climbing, walking speed, satisfaction level of the physician on functional as well as cosmetic outcome have also evaluated as secondary outcomes. Though there is no significant difference in the Sickness Impact Profile scores to the level of amputation, they have found that through knee amputees have lowest scores. Moreover, study has found that walking speed of transtibial amputees is significantly greater than transfemoral amputees. Furthermore, physicians are less satisfied with functional as well as cosmetics outcomes of the patients with through knee amputation. They have concluded that the management has to consider about above knee and through knee amputation patients since they have less functional outcomes.

Schnall, Chen, Bell, Wolf, & Wilken (2016) had done a study to find functional outcome of service holders who are undergone bilateral above knee and trough knee amputation. The aims of the study were to measure the quality of the rehabilitation program, expectations on the outcomes and factors influence in rehabilitation process. Measures on ambulation had taken at the beginning and one year later to compare functional outcome and progress of rehabilitation program. 6 minute walk test, Activity specific Balance Confidence and functional scale questionnaire were used to measure the functional outcomes of 10 participants. Furthermore, stair ambulation (ascent time and stair assessment index score) was measured among 6 participants who are capable of. Additions to that, patients are used to use their prostheses in all the visits of rehabilitations. They have found significant difference of 6 minute walk at the beginning and one year after rehabilitation. Nevertheless, the study did not found any significant difference in stair assessment index score. However, they have found the significant improvement in stair ambulation confidence scores at the end of rehabilitation. The study is concluded that the rehabilitation program is confident enough to achieve functional ambulation of bilateral trance femoral and knee disarticulation patients and the study recommended to have the modifications of programs as patients can achieve long distance community ambulation also.

Mahon et al. (2017) has measured functional outcomes and gait of unilateral above knee amputees. The aims of the study were to find changes of body structures due to limb loss and its effect on mobility and quality of life. In additions to that, study was aimed to find the association between body mechanical changes due to prosthesis and risk of falling and energy utilization. 67 young active military traumatic unilateral amputees were selected to measure physiological, functional, biomechanical and subjective to achieve study objectives and 76 uninjured males were used as the control group. The study have found that low stability, high trunk velocity and step width, high risk of low back and knee pain, greater trunk lateral flexion, larger vertical ground force relatively to the control group. Furthermore, study revealed that participants have poor efficacy of walking and larger oxygen consumption comparatively to the controls. The study concludes that unilateral trans-femoral amputees have low functional outcomes and gait comparatively to normal individuals and the study recommended that these amputation patient wants more rehabilitation interventions and better follow up to improve their quality of life.

All these studies explained the importance of proper rehabilitation after amputation surgery which specially targeting on having improvement of physical as well as cardiorespiratory functions. Different studies have used different scales, questionnaires and tests to measure the outcome of theses rehabilitation programs. In addition to that all these studies are conducted in different countries which are having quit different cultural context comparatively to Sri Lanka. Hence it was important to conduct separate study about the rehabilitation programs for patients with amputation and outcome of these patients after rehabilitation in Sri Lankan context. Sri Lanka is a developing country and have less laboratory equipment and spaces to conduct more researches. Based on the literature, Locomotor Capability Index (LCI) and Amputee Mobility Predictor with Prosthesis (AMPPRO) are the most reliable, validated and user friendly questionnaire which is applicable to use in Sri Lankan context to analysis the participants' physical functioning. Moreover, Six Minute Walk Test (6MWT) is a most reliable and low cost field test that can use even in Sri Lankan context to measure cardiorespiratory functions of amputation patients. Hence this study focused to use above mentioned scales, questionnaires and field tests while conducting the study.

Chapter III
METHODOLOGY

3.1. Objectives of Study

3.1.1. General objective

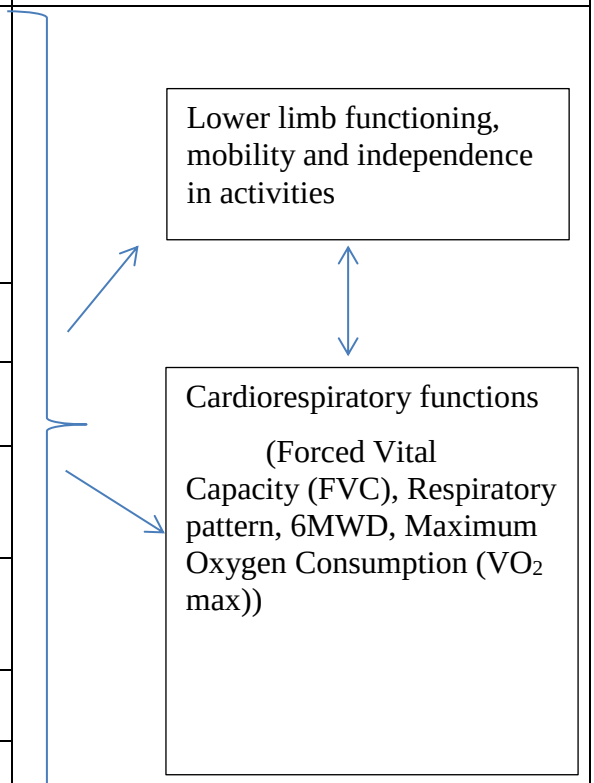
- To determine physical and cardiorespiratory functioning of patients with unilateral lower limb amputation in relation to sociodemographic, amputation and rehabilitation characteristics

3.1.2. Specific objectives

- To identify variations of socio-demographical and amputation status of patients with unilateral lower limb amputation
- To determine the physical functioning and cardiorespiratory functions of patients with unilateral lower limb amputation
- To evaluate the impact of socio-demographical and amputation status on the physical and cardiorespiratory outcomes
- To explore the association between cardiorespiratory functioning and physical functioning
- To identify patterns of functional level of the patients with unilateral lower limb amputation
- To explore the quality of basic management and rehabilitation guidance, level of satisfaction, and barriers of patients with unilateral lower limb amputation

3.2. Conceptual Framework

Table 3.1. Conceptual Framework

Independent Variables	Dependent variables
Socio-demographical data (age, occupational status, Marrital status, ethnicity, monthly family income, education level, history of injury….)	
Data on amputation	
Data on phantom symptoms	
Data on prosthetic fitting and satisfaction	
Activities on daily living like walking	
Data on hygiene	
Qualitative analysis data (medical and rehabilitation guidance, satisfaction, barriers)	

3.3. Study Design

Observational cross-sectional study was conducted to determine physical and cardiorespiratory functions, and their associated factors of adults with unilateral lower limb amputation. Data was collected using both quantitative and qualitative methods.

3.4. Study population

Studies found that individuals' with lower limb amputation have faced more limitations of functional activities rather than upper limb amputees (Esfandiari et al., 2017). Moreover, studies found that unilateral lower limb amputation is more common than other amputation surgeries as well as percentage of male amputees is higher than female percent in Sri Lanka (Ubayawansa, 2016). Though the female percentage is less, this study considered both the male and female unilateral amputation patients as the study population.

3.5. Study area/site

The study was conducted in Centre for Handicapped, Kandy, Sri Lanka as this is the one of the biggest and functional rehabilitation centre which provides artificial limbs and rehabilitation service for lesser amount of cost. In addition to that higher number of patients from different areas of the country is visiting this centre in order to have rehabilitation. Patients' personal information was taken like telephone numbers to contact later if necessary.

3.6. Study period

Data collection was conducted from September 2019 to February 2020.

3.7. Sample size

Since there is no prevalence of amputation population, sample size could not calculate using equation. Therefore, patients that supposed to assess from September 2019 to February 2020 was considered as the sample size and sample size was limited to 48 patients due to larger amount of patients are fallen into one or several categories of exclusion criteria and due to time and cost constraints.

All these participants was interviewed face to face to fill the therapist administrative questionnaires in order to gather quantitative data and all the participants were assessed for cardiorespiratory functioning. The qualitative part of the study was started with randomly selected few participants and continued the interviews until come to saturated point with 20 participants.

3.8. Inclusion and Exclusion Criteria

Some scholars have claimed that lung function is changing with age due to the physiological changes in respiratory system (Sharma & Goodwin, 2006; Wahba, 1983). In addition to that individuals' physical functions are reducing with aging which directly affect functional outcome of the rehabilitation process. Hence, adults' aged between 20 to 60 years was taken for the study in order to control these confounding factors during data collection. Adults who faced to the amputation due to traumatic injuries or congenital impairments were considered as another inclusion criteria for the study as other indications of amputation directly impact on respiratory and cardio vascular function which make the miss guidance of data (Kurdibaylo, 1994). In addition to that those individuals should not have any injury or paralysis to

the other sound leg since any injury to contralateral side may hugely affect the functional outcome of the amputees. Further, study considered the individual who underwent the amputation surgery 6 months before the study since patients have to pass the acute effect to check the functional level as well as the prosthesis are prescribed after six months of amputation (Kurdibaylo, 1994). In contrast, individuals' who are with prior history of cardiovascular and respiratory diseases and Diabetes Mellitus (DM) consider as the exclusion criteria for the study. In addition to that, individuals with morbid obesity who have Body Mass Index (BMI) above 34.5, heavy smokers and individuals who are contacting with dust, chemical or heavy metals continuously for longer period also excluded from the study as these factors directly affect to decline the lung functions of particular individuals (Quanjer et al., 2012) (see Table 3.2).

Table 3.2. Inclusion and Exclusion criteria of the study

<table>
<tr><th>Inclusion Criteria</th><th>Exclusion Criteria</th></tr>
<tr><td>Aged less or equal 60 years</td><td rowspan="2">Individuals' who are with prior history of cardiovascular and respiratory diseases and diabetes mellitus</td></tr>
<tr><td>Amputation due to traumatic injuries or congenital impairments</td></tr>
<tr><td>Individuals who are not having any injury or paralysis of the contralateral leg</td><td>Individuals who exposed to dust, chemicals or heavy metals</td></tr>
<tr><td rowspan="2">Underwent unilateral amputation surgery 6 months before the study</td><td>Individuals with morbid obesity</td></tr>
<tr><td>Heavy smokers</td></tr>
</table>

3.9. Sampling technique

Purposive sampling method was used to collect data from the patients who are visited the Center for Handicapped, Kandy, Sri Lanka for their rehabilitation process. Since there are no statistics regarding amputation population in Sri Lanka, other sampling methods is difficulty to perform. However, this method also can convey as a kind of random sampling due to sample is selecting without any biasness.

3.10. Data collection tools/materials

3.10.1. Personal details of the participants

Self-constructed and therapist administrative questionnaire was developed to determine the socio-demographical status and details on present medical and rehabilitation process as well as past medical history (Appendix A1).

3.10.2. Assessment of Physical functional level

Locomotor Capabilities Index (LCI) (Appendix A2) (Treweek & Condie, 1998) and Amputee Mobility predictor with prosthesis (AMPPRO) (Appendix A3) was used to analysis the participants' physical functional level (Agrawal, 2016; Esfandiari et al., 2017; Gailey et al., 2002).

LCI was used to find out the mobility level and how well participants are doing ambulation independently. It consists of 14 questions which are assessing basic and advanced skill of individuals under 5 levels to identify the level of independency. Level 5 indicates that an individual can perform daily activities independently without even assistive devices while level 1 indicates that individual cannot perform the tasks in daily living even with someone else support (Franchignoni, Orlandini, Ferriero, & Moscato, 2004).

In addition to that AMPPRO was used to assess the participants' mobility and functional ambulatory level with the prosthesis with the maximum score of 47. Physical function has classified into 5 level functional classification system called Medicare Functional Classification Level (MFCL) which consist of levels K0-K4 and the level is determined based on the score that an individual achieved (Table 3.3) (Gailey et al., 2002).

Table 3.3. MFCL classification with the description

Level	Score	Description
K0	N/A	"The patient does not have the ability or potential to ambulate or transfer safely with or without assistance and a prosthesis does not enhance their quality of life or mobility".
K1	15-26	"The patient has the ability or potential to use a prosthesis for transfer or ambulation on level surface at fixed cadence. Typical of the limited and unlimited household ambulatory".
K2	27-36	"The patient has the ability or potential for ambulation with the ability to transverse low-level environmental barriers such as curbs, stairs or uneven surfaces. Typical of the limited community ambulatory".
K3	37-42	"The patient has the ability or potential for ambulation with variable cadence. Typical the community ambulator who has the ability to traverse most environmental barriers".
K4	43-47	"The patient has the ability or potential for prosthetic ambulation that exceeds basic ambulation skills, exhibiting high impact, stress or energy levels".
(Gailey et al., 2002; Schober, Boer, & Schwarte, 2018)		

3.10.3. Assessment of cardiorespiratory functioning

3.10.3.1. Spirometry Test

The Spirometry test is conducting to find lung capacities such as forced vital capacity (FVC), forced expiratory volume within first second (FEV1), FEV1/FVC%, peak expiratory flow rate (PEFR) (National Health and Nutrition Examination Survey [NHANES], 2008). Each individuals' standing height, weight, BMI, age, gender, ethnicity, and smoking states should enter to the lung function machine before conducting the test. Height was measured without shoes using a calibrated stadiometer to the closest full centimeters and weight with light clothing in kilograms up to one decimal point. BMI was calculated using individuals' height and weight.

$$BMI = Weight\ (Kg) / Height\ (m^2)$$

Individuals' age was calculated using the difference between the test date and the subject's date of birth nearly full years.

Patients were instructed to do the test followed by individual data entry to the machine (Figure. 3.1). The test procedure as follows;

1. Individuals were asked to place a mouthpiece which attached to the spirometer in their mouth. Making a tight seal with the lips were important to ensure all the air to be measured passed in and out through the spirometer and instructed to wear nose clips to prevent air leaking through nose.
2. After a normal breath they were instructed to slowly blow out until the lungs were empty.
3. Then advised to take a large, deep breath to fill up their lungs completely.
4. As soon as their lungs are filled maximally, they were advised to blow out as hard and as fast as they could until the lungs were completely empty.
5. Then advised to take a large deep breath to fill the lungs maximally to terminate the procedure.
6. A minimum of three successive acceptable spirograms were recorded

Figure 3.1. Procedure of performing the Spirometry

Parameter	UM	Pred.	TEST#2	%Pred.
Best FVC	l(btps)	2.60	2.70	104.0
FVC	l(btps)	2.60	2.70	104.0
FEV1	l(btps)	2.20	2.54	115.4
PEF	l/sec	5.81	5.91	101.7
PIF	l/sec		4.65	
FEV1/FVC%	%	80.0	94.2	117.8
FEV1/VC%	%	80.0	70.8	88.5
FEF25-75%	l/sec	3.19	3.74	117.2
MEF75%	l/sec	5.29	5.65	106.6
MEF50%	l/sec	3.68	4.84	131.3
MEF25%	l/sec	1.51	1.88	124.6
FET100%	sec		1.4	

Figure 3.2. Output measures of the Spirometry
(https://www.google.lk: spirometry test)

Flow-volume spirometry data; both the predicted and test values were generated electronically in the machine after test completed and those results were recorded (Figure. 3.2) (Appendix 4). Lung functions values of the patients and their predicted values were compared to draw the conclusion on particular individual's health status like normal, restrictive or obstructive or mixed lung disease pattern (Figure. 3.2 and

3.3) (Johnson & Theurer, 2014; National Health and Nutrition Examination Survey [NHANES], 2008).

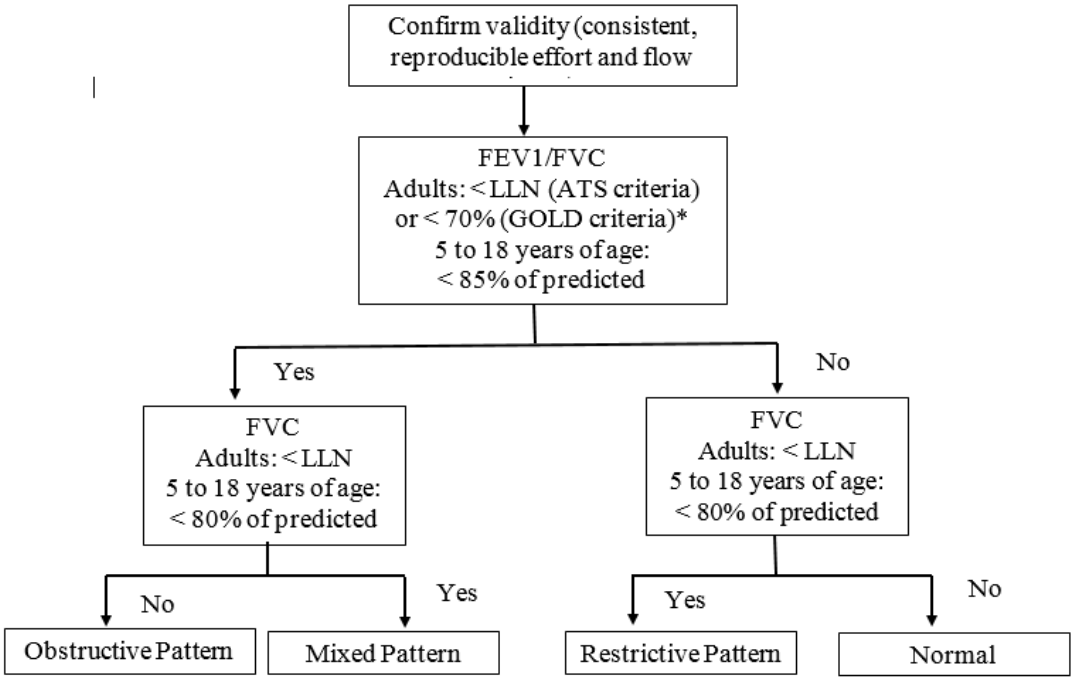


Figure 3.3. Interpretation of Spirometry test results
(Johnson & Theurer, 2014)

3.10.3.2. Six Minute Walk Test

Participants was guided to perform the 6MWT to assess their general function, mobility and morbidity level, cardiorespiratory endurance (Agrawal, 2016). Test was conducted based on American Thoracic Society (ATS) guidelines. Base on the guidelines 30m distance flat area was marked using cones and marks were put in every 3m to make it easier to count the distance that an individual walks. Then, necessary equipment were arranged such as countdown timer, a chair that can be easily moved along the walking path, sheets to record the test measures, sphygmomanometer and pulse oximeter ("American Thoracic Society Statement : Guidelines for the Six-Minute Walk Test," 2002; Burr, Bredin, Faktor, & Warburton, 2011; Dumke, 2018; Jalili, Nazem, Sazvar, & Ranjbar, n.d.) (Appendix 4)

Basic health status such as resting hart rate (RHR), blood pressure (BP) and saturation level (PaO_2) were assessed before conducting the test to confirm the eligibility for the test. Then participants were instructed to walk 30m distance with their maximum speed as maintain the same speed throughout the six minutes. Further, they were instructed that they can use their assistive device if there is any, they can

rest or sit if they feel any difficulty while walking. Then, the test was started and when a participant come back to the starting point after 60 m walk was considered as a one lap. Finally number of laps completed within six minutes were counted and multiplied by 60 to calculate the six minute walk distance (6MWD). End heart rate (EHR), BP, PaO_2 and rate of perceived exertion using Borg scale (Appendix A5) were assessed to complete the test ("American Thoracic Society Statement : Guidelines for the Six-Minute Walk Test," 2002; Burr et al., 2011)

Cardiorespiratory functional level was assessed based on the data gathered before and after the test. Mobility level was assessed by comparing the individuals walking distance and their predicted values. Predicted values for 6MWT was calculated for men and women separately using following equations which develops based on the data of non-disable healthy individuals (Dourado, 2010; Enright & Sherrill, 1998).

6 minute distance for Men = (7.57*height (cm)) - (5.02*age (years)) - (1.76*weight (kg))-309

6 minute distance for Women = (2.11* height (cm)) - (2.29* weight (kg)) – (5.78* age (years)) + 667

Cardiorespiratory endurance was measured as maximum oxygen consumption (VO_2max) which calculated using each individuals six minute distance. VO_2max calculation equation as follows;

$$\begin{aligned} VO_2\max(\mathrm{ml.kg^{-1}.min^{-1}}) = \\ = 70.161 + (0.023 \times 6\mathrm{MWD[m]}) - (0.276 \times \mathrm{weight[kg]}) \\ - (6.79 \times \mathrm{sex, where\ m} = 0, \mathrm{f} = 1) \\ - (0.193 \times \mathrm{resting\ HR[beats\ pr\ minute]}) \\ - (0.191 \times \mathrm{age[yr]}) \end{aligned}$$

Where, m=distance in meters; yr = year; kg = kilogram (Burr et al., 2011)

Calculated VO_2 max results categorized according to the standard normal values for cardiorespiratory functioning (Appendix A6) (Dumke, 2018).

3.10.4. Qualitative study

Main focus of the qualitative study was to determine the quality of basic management and rehabilitation guidance, level of satisfaction, and barriers of patients with unilateral lower limb amputation. Face to face interviews with unstructured open ended questionnaire (Appendix A7) and audio recording were used for data collection.

Interviewed was started with few of them individually and interviewing them one after each other, analyzed the results and labelled the data. As they have added new insights, then interviewed one patient more and analyzed, and labelled. Then, continued the same process till saturation and stopped the data collection at a number of 20 patients.

3.11. Data management and analysis

Descriptive analysis was conducted to find out the distribution, mean, median, standard deviation (SD), minimum and maximum of continues data based on the gender and descriptive statistics of categorical data was presented as pie charts and bar charts with relevant percentages. Pearson correlation, spearman's rank correlation, independent sample t test, Mann-Whitney U test and Analysis of Variance (ANOVA) test were conducted to find the association between socio-demographical status and functional outcomes. Pearson correlation, chi squared and ANOVA test were conducted to find the association between association between physical functions and cardiorespiratory functions. All these statistical analysis were measured at 5% significant level with 95% confidence interval (CI). Level of the correlation was interpreted based on a Conventional Approach to interpreting the size of correlation coefficient (Table 3.4) (Schober et al., 2018).

Table 3.4. Interpreting the size of correlation coefficient

Absolute Magnitude of the Observed Correlation Coefficient	Interpretation
0.00–0.10	Negligible correlation
0.10–0.39	Weak correlation
0.40–0.69	Moderate correlation
0.70–0.89	Strong correlation
0.90–1.00	Very strong correlation

(Schober et al., 2018)

Moreover, both average and complete linkage hierarchical cluster analysis was performed to identify the variation of overall functional level of participants. Three categories of functional outcomes found based on cluster analysis were compared with gender and previous job engagement using Chi-squired test. Further, content analysis of qualitative data was arranged to determine the quality of basic management and rehabilitation guidance, level of satisfaction, and barriers of patients with unilateral lower limb amputation. The steps of content analysis was as followed (Figure 3.4).

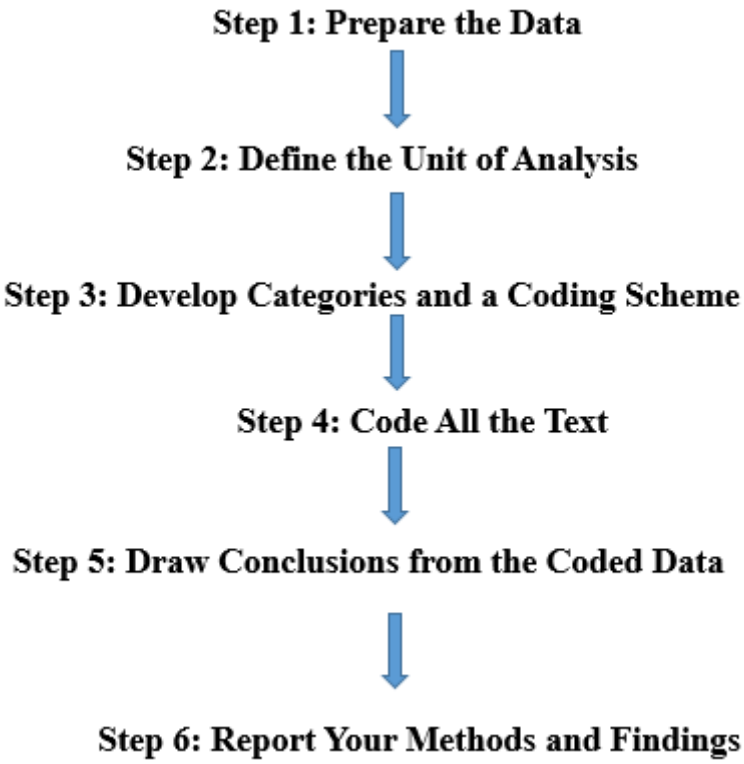


Figure 3.4. Steps of Content analysis

3.12. Quality control and quality assurance

Quality control and quality assurance was maintained by selecting participants as strictly adherence to the proposed criteria, converting all questioners in to Sinhala language with the support of expert professionals. In addition to that, all the test equipment were calibrated before using and tests such as spirometry was conducted at least three times to until the patient achieving their maximum lung function.

Information of all the participants were numbered according to the order of participation and entered, and stored in a computer according to the numbering. All these entered data are kept in a locked folder as no one can access except the principal investigator. Further, recorded qualitative information were translated accurately into English without changing real meaning of the opinions and ideas of the patients and all these record also stored in the same locked folder where other information were stored.

3.13. Ethical consideration

Data collection was stared after receiving the approval from the Research and evaluation unit, CRP, Savar and from Center for Handicapped, Kandy, Sri Lanka (Appendix A8, A9 and A10). Written informed consent to participate in the study (Appendix A11and A12) was taken before collecting the data from patients.

Chapter IV

RESULTS

4.1. Variation of Socio-Demographical and Amputation Status

4.1.1. Socio-demographical Analysis

Normal Q-Q plots were plotted to find the normality of continuous data age, height, weight, BMI, monthly income, years of schooling and found that data is normally distributed.

Table 4.1. Descriptive statistics of socio-demographical data

Variable	**Female (n=14) (29.2%)**		**Male (n=34) (70.8%)**		**Independent sample t test (p value)**
	Mean ± SD	Range	Mean ± SD	Range	
Age (Years)	45.64 ± 11.331	26 - 60	42.06 ± 10.929	21-60	0.312
Height (cm)	152.64 ± 4.012	147 - 158	164.76 ± 6.537	153-183	0.000*
Weight (kg)	50.14 ± 5.021	40 - 56	62.90 ± 11.585	43-88	0.000*
BMI (kg/m^2)	21.52 ± 2.020	17.8 -25.1	23.19 ± 4.139	14.9-32.3	0.067
Monthly income (SL Rs.)	10642.86 ± 10911.230	0 - 30000	25441.18 ± 27027.698	0-76000	0.247
Years of schooling (years)	8.93 ± 3.198	3 - 13	10.26 ± 3.736	3-22	0.010*

SL Rs.– Sri Lankan Rupees, n- number of participants, SD- Standard Deviation, *- variables with significance difference, at 5% significant level

Socio-demographical data is presented in the Table 4.1 with mean, SD, minimum and maximum. Thirty four (70.8%) males and fourteen (29.2%) female has participated for the study and found that males height, weight and years of schooling are significantly higher than females. Though there is no significance difference, average monthly income is higher in males rather than females. In addition to that the results found that monthly income (Rs. 57888.89 ±17996.142) of the participants those who worked in forces before amputation is significantly higher (P = 0.000) than

the monthly income (Rs. 12641.03±16434.459) of the participants those who engaged in civil occupations.

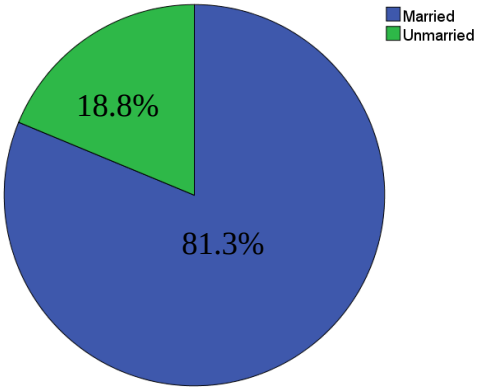


Figure 4.1. Distribution of marital status

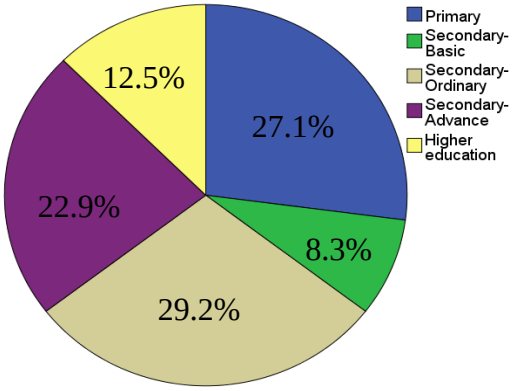


Figure 4.2. Distribution of education level

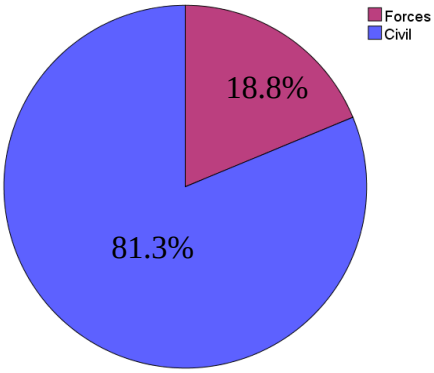


Figure 4.3. Job engagement before amputation

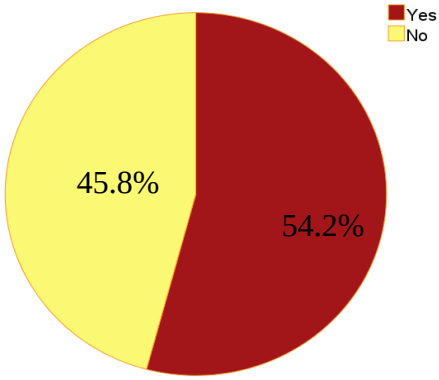


Figure 4.4. Current job engagement

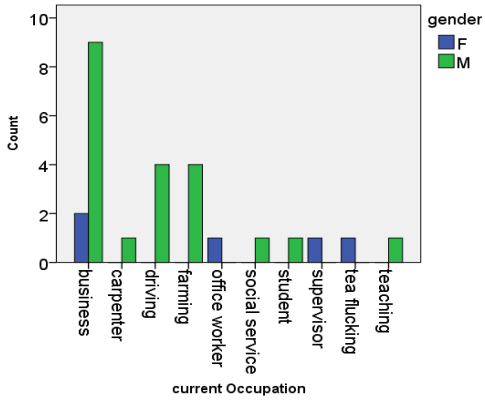


Figure 4.5. Type of the current occupation

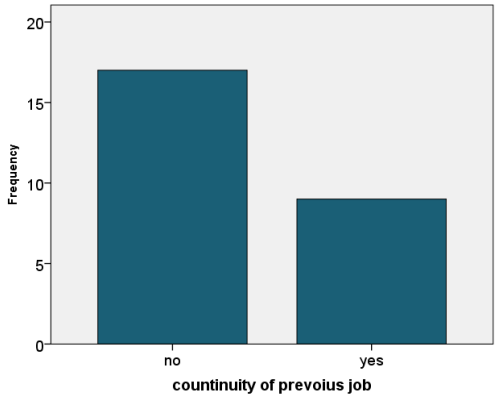


Figure 4.6. Continuity of previous job at present

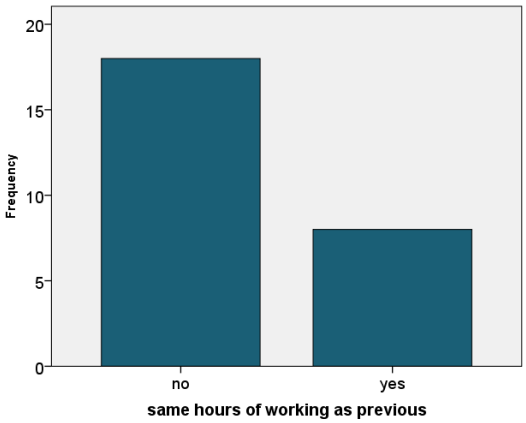


Figure 4.7. Presentation of engagement of same working hours as previous

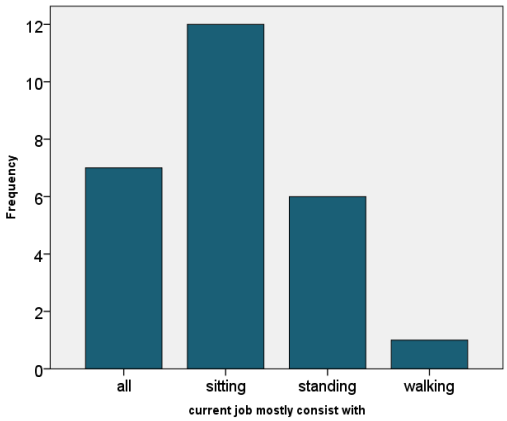


Figure 4.8. Activity level of current job

Figure 4.1 to Figure 4.9 is presented the distribution of categorical variables of socio-demographical data. More than 80% of participants were married. Basically education level has divided in to five categories in Sri Lanka and individuals completed degree and higher consider as higher education, individuals completed advance level exams considered as secondary advance, individuals completed ordinary level examination considered as secondary ordinary, individuals completed up to grade 10-11 considered as secondary basic and individuals completed up to grade 5-9 consider as primary. According to the figure 4.2, more than 60% of them have educated up to secondary and above levels and can be considered that individual have good level of education level. Based on the Figure 4.3 and 4.4, all the participants had engaged in occupation where more than 81% of individuals engaged in civil occupations and 19% engaged in forces and it has reduced up to 54% after amputation. Figure 4.5 shows the types of occupations that individuals' engage in after amputation and found that higher number of them engaged in business like self-employments. Among those 54% of employers, only 34% of individuals are continuing the same occupation that they did before amputation showed in Figure 4.6. Nevertheless, 67% were not been able to work same hours as previous shows in Figure 4.7. In addition to that it has found that their activity level is less since most of the individuals (12 out of 26) engage in their occupation by sitting only (Figure 4.8).

4.1.2. Analysis of Amputation Data

Q-Q normality plots were plotted to check the normal distribution of data on amputation history and found that data are not normally distributed. Hence median, SD, minimum and maximum were calculated for duration of amputation, wearing prosthesis and rehabilitation respectively.

Table 4.2. Descriptive statistics of amputation data

Variable	**Female (n=14) (29.2%)**		**Male (n=34) (70.8%)**		**Mann-Whitney U test (p value)**
	Median ± IQR	Range	Median ± IQR	Range	
Time since amputation (Years)	17 ± 11.07	2-43	7.5 ± 9.09	0.5-35	0.011*
Duration of wearing prosthesis (Years)	14.5 ± 9.48	1.5-35	5.5 ± 8.74	0.02-34	0.014*
Time interval between surgery and admission for rehabilitation	1.75 ± 2	0.5-9	1 ± 1.5	0.5-8	0.089
Duration of rehabilitation (Months)	0.5 ± 1.46	0.25-6	1 ± 5.38	0.25-24	0.033*

n- number of participants, IQR- Inter Quartile Range, *- variables with significance difference, at 5% significant level

According the results, duration of amputation is varying from 6 moths to 43 years and their duration of taking rehabilitation is varied from 2 weeks to 2 years. Time interval between surgery and admission for rehabilitation varying from 0.5 to 9 years which means most of the individuals direct for rehabilitation in early stage of amputation which is a good trend. Further, there are a significance differences in duration of amputation, wearing prosthesis and rehabilitation among genders (Table 4.2). In addition to that it has found that participants who worked in forces has taken significantly longer duration of rehabilitation (6 months ±12.25) (P = 0.1) rather than the participants who engaged in civil occupations (0.5 months ± 0.5). Nevertheless there is no significance difference in time interval between surgery, and admission for rehabilitation in respect to the job category.

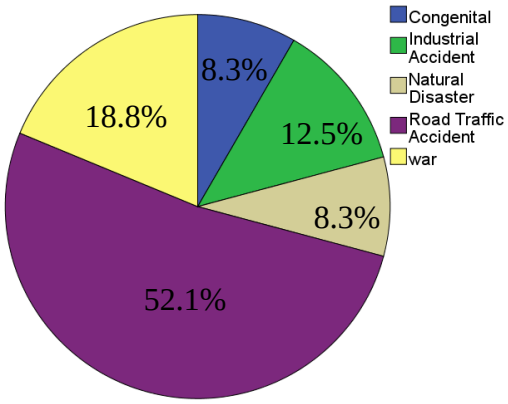


Figure 4.9. History of injury

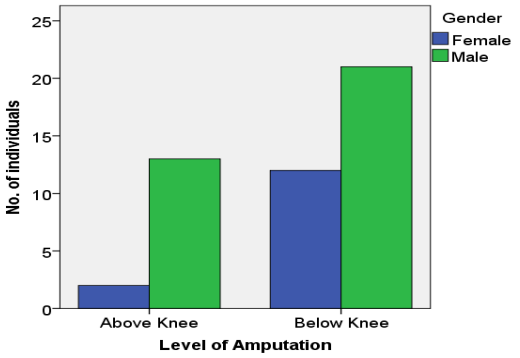


Figure 4.10. Level of amputation by gender

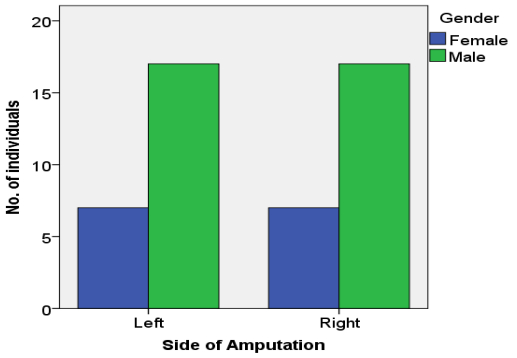


Figure 4.11. Side of amputation by gender

Figure 4.9 shows that, 52% study participants have undergone amputation due to road traffic accident (RTA) among all other causes based on inclusion criteria. Further it is found that below knee amputation is more common as well as males are undergoing amputation more than females in this sample and there is no difference of side of the amputation (Figure 4.10-4.11).

4.1.3. Analysis of Stump Condition

Data were analyzed to find the condition of the stump such as shape, swelling, scar condition and presence of blisters of the amputation patients and results show that more than 90% of patients have good conditions of all the parameters (Figure 4.12-4.15).

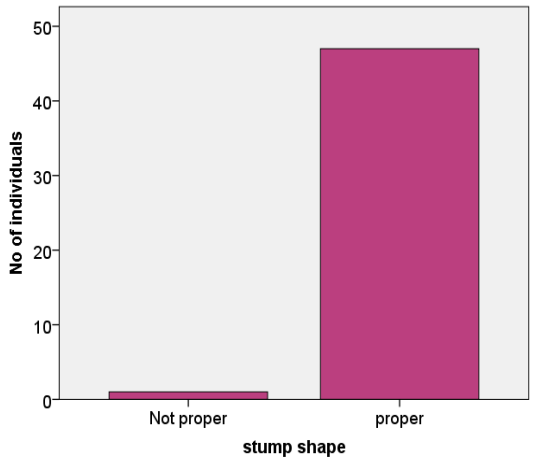


Figure 4.12. Details on stump shape

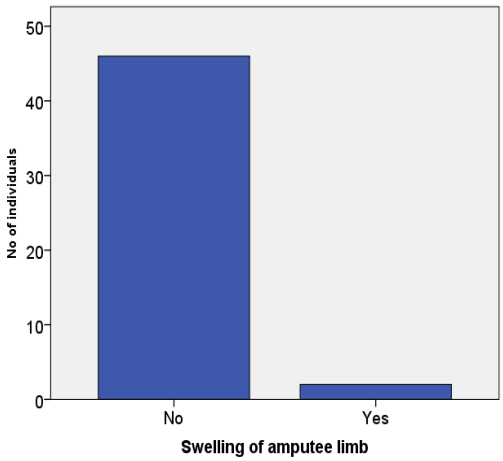


Figure 4.13. Details on swelling of amputee limb

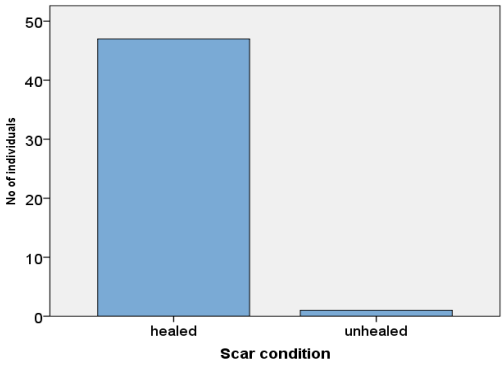


Figure 4.14. Condition of the scar in amputee area

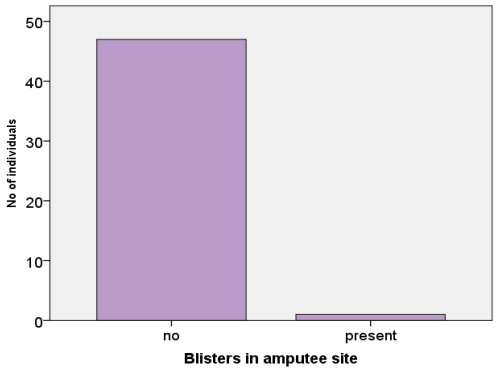


Figure 4.15. Blisters around the amputee site

4.1.4. Analysis of Phantom Pain

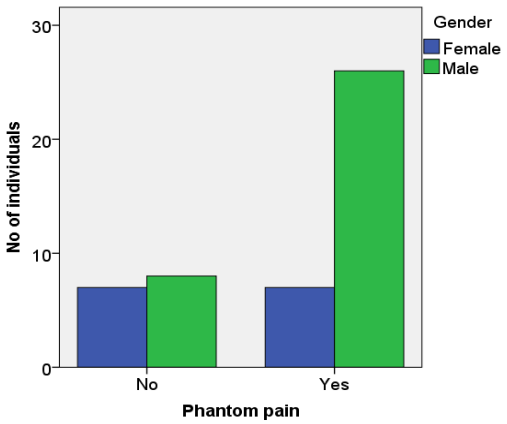


Figure 4.16. Phantom pain by gender

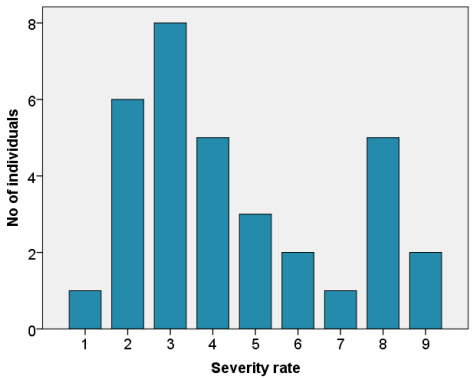


Figure 4.17. Severity rate of individuals based on VAS score

Table 4.3. Severity of phantom pain

Variable	Female (n=7) (21.2%)		Male (n=26) (78.78%)		Independent sample t test (p value)
	Mean ± SD	Range	Mean ± SD	Range	
Pain severity	4 ± 2.236	2-8	4.65 ± 2.449	1-9	0.529

n- number of participants, SD- Standard Deviation, *- variables with significance difference, at 5% significant level

Table 4.4. Comparison of phantom pain and years of amputation

Variable	Phantom pain present (n=33)	Phantom pain absent (n=15)	Mann-Whitney U test (P value)
	Median ± IQR	Median ± IQR	
Time since amputation	8 ± 8.70	15 ± 12.28	0.095
Monthly income	20000 ± 30500	1500 ± 22500	0.092

n- number of participants, IQR- Inter Quartile Range, *- variables with significance difference, at 5% significant level

Figure 4.16 shows that, 33(69%) individuals have phantom pain from total and 76% (n=26/34) of males as well as 50% (n=7/14) of females have phantom pain based on gender. Severity of phantom pain is varying from 1 to 9 among the individuals and higher number of individuals is having severity level 3 based on the visual analog scale (VAS) (Figure 4.17). There is no significant difference of pain severity among genders (Table 4.3) and presence of the phantom pain do not significantly depend on the years of amputation or monthly income (Table 4.4) or gender (p=0.72 with χ^2 value 3.234).

4.1.5. Analysis of Hygiene Level

Hygiene level of the individuals was analyzed based on cleaning of the stockings, stump and cleaning of the prosthesis. Figure 4.18 shows that, only 35% of individuals are cleaning of their stocking daily and most of them are used to do it twice a week which is not a good hygiene practice. It is shows that 40% of male are having good practice of stocking cleaning which is exactly twice from females' practice (Figure 4.19). Further, results shows that 91% of individuals are cleaning their stump with soap and normal water where only 8.3% of individuals practicing proper stump cleaning with soap and warm water (Figure 4.20). According to the Figure 4.21, there is no difference between genders on cleaning of their stump.

Around 55% of individuals having good practice of cleaning prosthesis and most of them are female among them (Figure 4.22 and 4.23). Hence, results conclude that individuals are having average level of knowledge on proper hygienic practices after amputation.

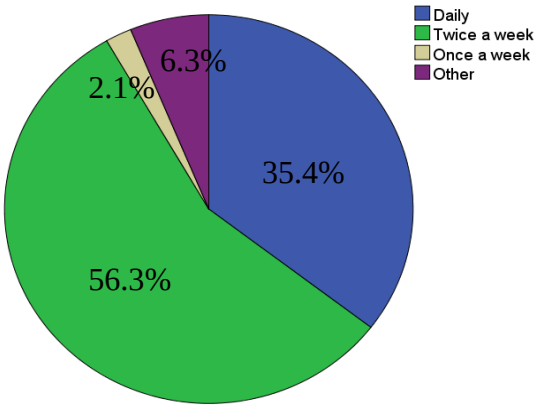


Figure 4.18. Presentation of stocking washing

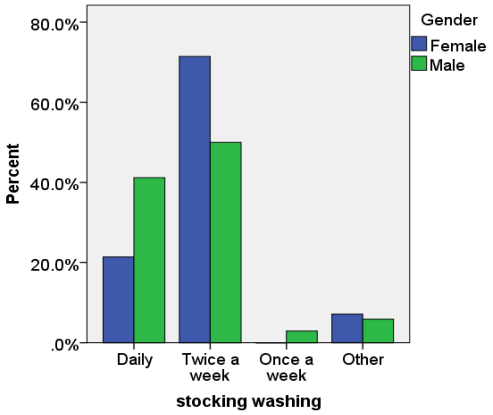


Figure 4.19. Stocking washing based on gender

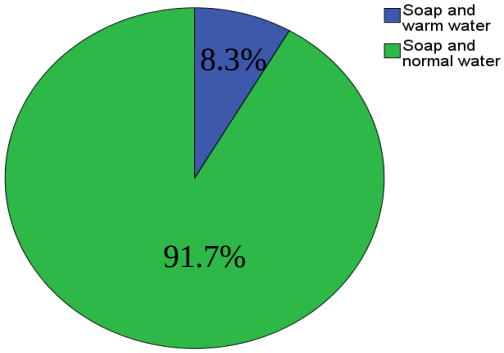


Figure 4.20. Presentation of cleaning of stump

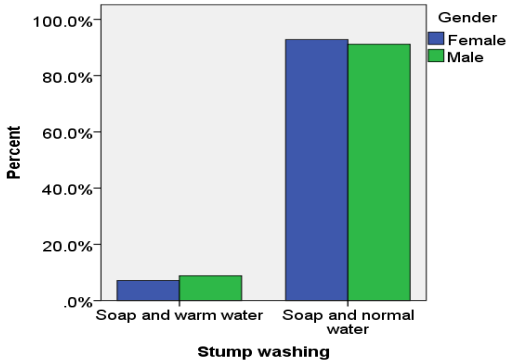


Figure 4.21. Cleaning of stump based on gender

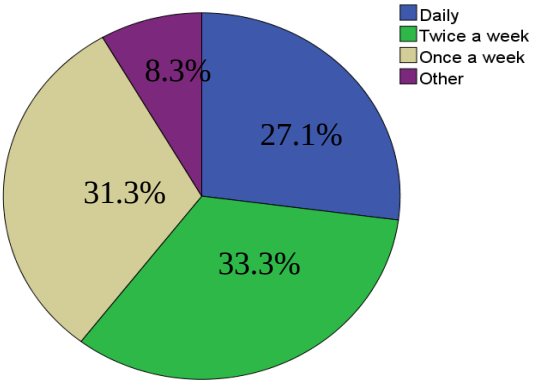


Figure 4.22. Presentation of prosthesis cleaning

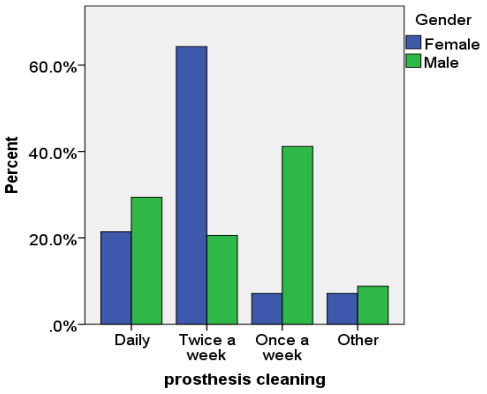


Figure 4.23. Prosthesis cleaning based on gender

4.1.6. Analysis of Prosthesis Usage

Usage of prosthesis and satisfaction of the individuals are counted and results show that 34 (71%) individuals are using the prosthesis always with 69% of high level of satisfaction (Figure 4.24 and 4.25).

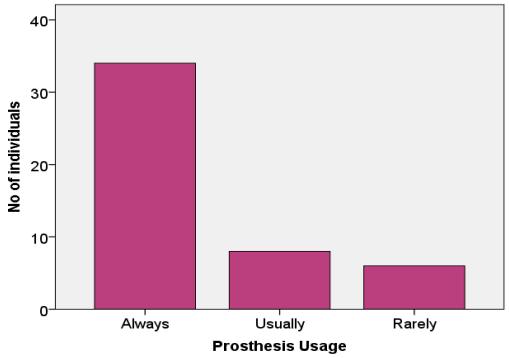


Figure 4.24. Prosthetic usage of individuals

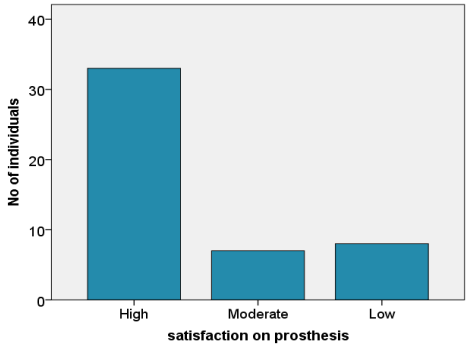


Figure 4.25. Satisfaction of prosthetic usage

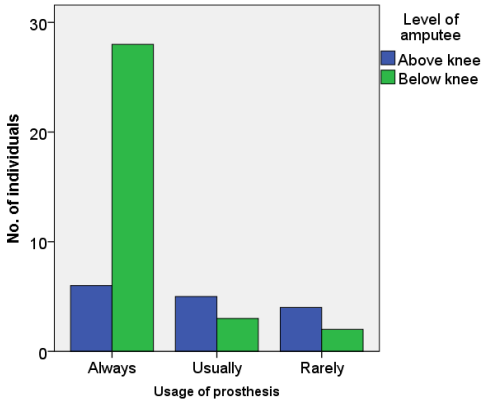


Figure 4.26. Prosthetic usage of individuals based on level of amputation

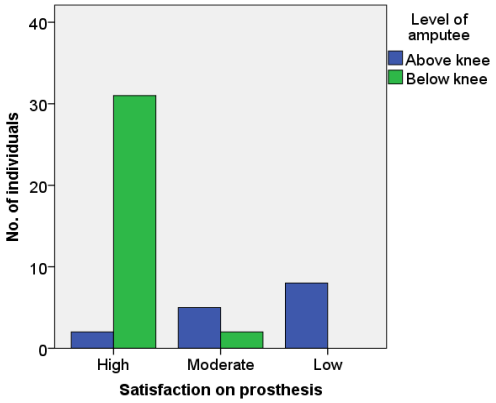


Figure 4.27. Satisfaction of prosthetic usage based on level of amputation

Table 4.5. Relationship of prosthetic usage with satisfaction, gender and level of amputation

Variables	Chi squared value	p value
Prosthetic usage ~ satisfaction	25.071	0.000*
Prosthetic usage ~ gender	0.688	0.709
Prosthetic usage ~ level of amputation	10.068	0.007*
Prosthesis usage ~ Phantom pain	1.58	0.454
Satisfaction of Prosthetic usage ~ gender	2.652	0.265
Satisfaction of Prosthetic usage ~ level of amputation	32.606	0.000*

*- variables with significance difference, at 5% significant level

Table 4.6. Comparison between Phantom pain severity and prosthesis usage

Testing variable	**Grouping variable Prosthetic usage (Mean ± SD)**			**ANOVA test (p value)**
	Always (n=22)	Usually (n=7)	Rarely (n=4)	
Phantom pain severity	4.23 ± 2.39	4.71 ± 2.75	5.75 ± 1.71	0.501

n- number of participants, SD- Standard Deviation, *- variables with significance difference, at 5% significant level

Further, results show that prosthetic usage is significantly associated with satisfaction of prosthetic usage. Further, prosthetic usage and satisfaction of prosthetic usage is significantly associated with the level of amputation and not associated to the gender (Table 4.5). Table 4.5 further shows that there is no significant association between phantom pain and prosthesis usage and Table 4.6 shows that there is no significant difference between phantom pain severity and prosthesis usage. Figures 4.26 and 4.27, show that individuals with below knee amputation have higher level of prosthetic usage and prosthetic usage satisfaction compared to individuals with above knee amputation.

4.1.7. Analysis of Mobility Level

Mobility level of the participants such as mobility hours with and without prosthesis was analyzed. Figure 4.28, shows that there are 14 individuals who are not using their prosthesis when doing basic mobility activities in their daily living and other 34 individuals have average 6 hours of mobility level per day with the prosthesis. Nevertheless, 14 individuals those who are not have mobility with the prosthesis have 2 to 3 hours of average mobility level per day without the prosthesis (Figure 4.29). According to the Figure 4.30, total mobility hours vary from 0 to 15 hours per day with and without the prosthesis and higher number of individuals have mobility level of 3 hours per day.

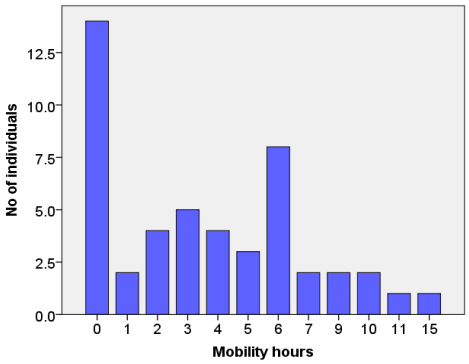


Figure 4.28. Mobility hours per day with the prosthesis

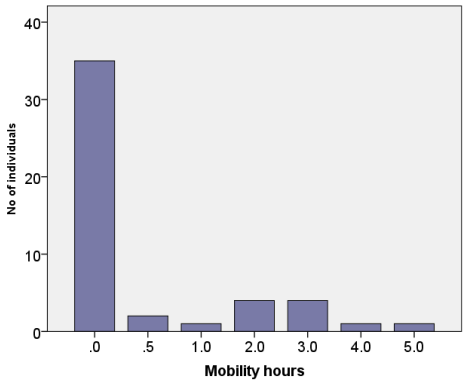


Figure 4.29. Mobility hours per day without prosthesis

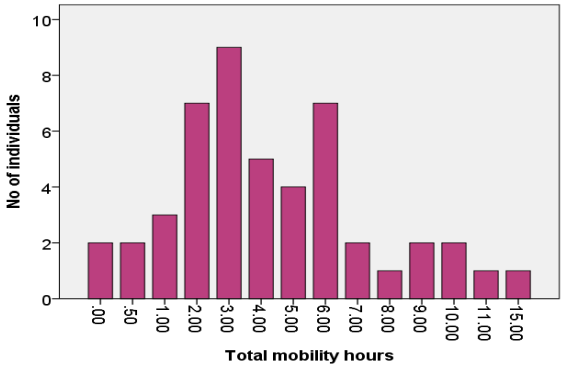


Figure 4.30.Total mobility hours per day with and without prosthesis

Table 4.7. Descriptive statistics of total mobility level with and without prosthesis

Testing variable	**Grouping variable (n)**		**Mean ± SD**	**Independent sample t test (p value)**
Mobility hours per day with prosthesis	Gender	Female (14)	4.43 ± 2.62	0.436
		Male (34)	3.53 ± 3.92	
	Level of amputation	AK (15)	1.67 ± 2.97	0.004*
		BK (33)	4.76 ± 3.46	
Average total mobility hours per day	Gender	Female (14)	4.82 ± 2.42	0.595
		Male (34)	4.28 ± 3.44	
	Level of amputation	AK (15)	3.13 ± 2.55	0.053
		BK (33)	5.03 ± 3.26	

n- number of participants, SD- Standard Deviation, *- variables with significance difference, at 5% significant level

Table 4.7 shows that there is no significant difference of average mobility hours per day by gender and level of amputation but there is a dependency between mobility hours with the prosthesis and level of amputation.

4.1.8. Usage of Walking Aids

Usage of external appliances and occasions of usage were analyzed. Result shows that 22 (45.8%) individuals are not using external appliances at all and 92% from other 26 individuals are using crutches for their mobility purposes (Figure 4.31). Figure 4.32 shows that 14 (53.8%) individuals are using external appliances all the time and 19% is using appliances when engage in activities at home without the prosthesis.

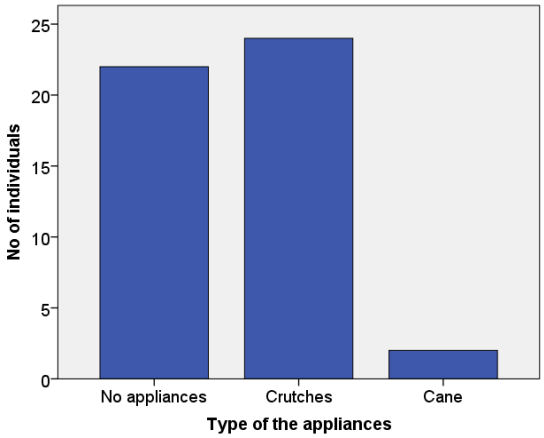


Figure 4.31. Type of external appliances

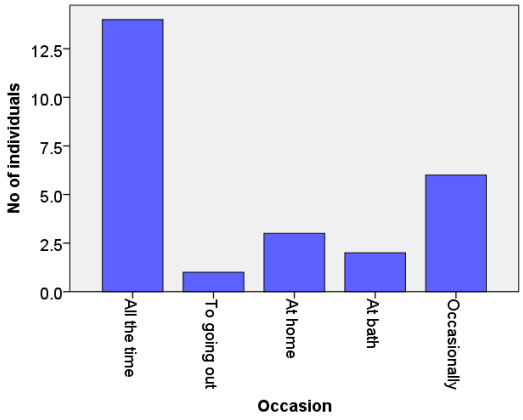


Figure 4.32. Occasion of usage of external appliances

4.2. Analysis of Physical Functioning

Level of physical function was analyzed based on AMPPRO scale and LCI. Descriptive statistics; mean, SD, minimum and maximum were analyzed since the data were normally distributed and results shows in Table 4.8. According to the table, female have higher level of physical functioning comparatively to the male. AMPPRO data were classified in to standard K levels where 47.9% patients with amputation are able to perform prosthetic ambulation which exceed the basic ambulation skills (K4 level). Further, the classification shows that around 65% of individuals have ability ambulate with the prosthesis in an environment with high level of barriers (Figure 4.33).

Table 4.8. Descriptive statistics of physical functional level with prosthesis

Variable	Female (n=14) (29.2%)		Male (n=34) (70.8%)	
	Mean ± SD	Range	Mean ± SD	Range
AMPPRO	40.29 ± 7.200	24-47	37.29± 7.986	17-47
LCI Basic	25.93 ± 2.947	21-28	24.35 ± 4.424	10-28
LCI Advance	25.43 ± 4.033	18-28	22.15 ± 7.345	7-28
LCI Total	51.36 ± 6.812	39-56	46.50 ± 11.328	18-56

AMPPRO- Amputee Mobility Predictor with Prosthesis, LCI- Locomotor Capability Index, n- number of participants, SD- Standard Deviation

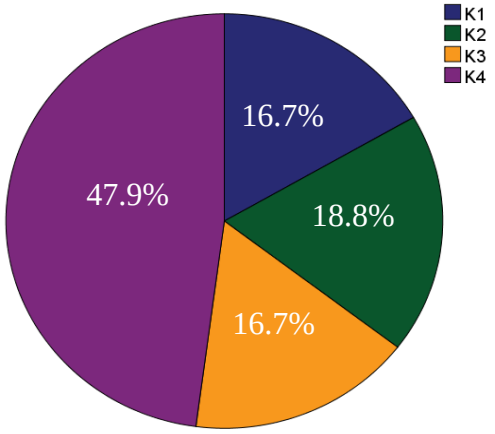


Figure 4.33. Physical functioning level based on AMPPRO score

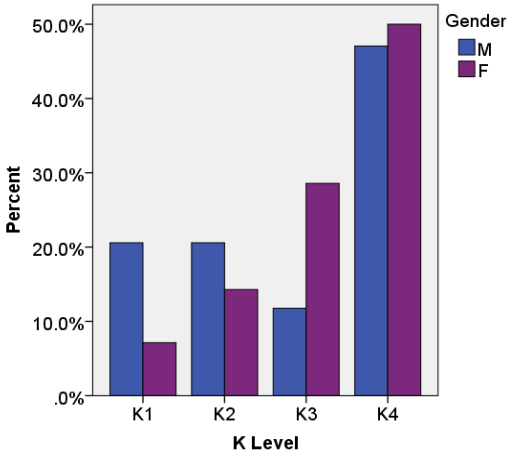


Figure 4.34. AMPPRO score category by gender

LCI 5 level classification shows how much independent the individual is when performing basic and advance daily activities. Figure 4.35 shows that, 96% of individuals can perform their daily activities independently with or without assistive devices while only 4% of individuals are seek help from others. 58.3% of individuals among 96% have ability to carry out daily activities independently without assistive devices. Percentage of individuals who can perform independently with or without assistive devices has reduced up to 83% when consider the advanced daily activities. In contrast, percentage of individuals who depend on some others has increased up to 17% when engage in advanced activities (Figure 4.37). The variation of independency and dependency of individuals for both basic and advance activities in LCI is mostly equal to the figures found in advance LCI classification levels (Figure 4.39). Female

have higher level of independence in all these three stages of LCI classification compared to the males (Figure 4.36, 4.38 and 4.40).

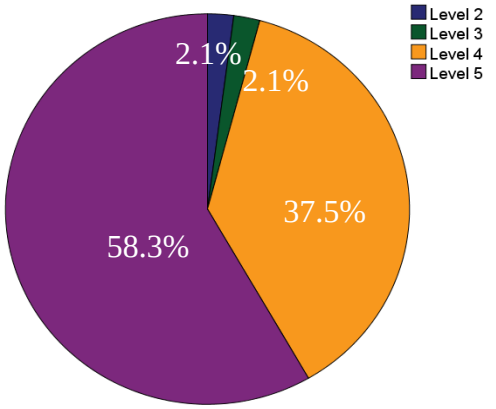


Figure 4.35. Physical functioning level based on LCI Basic score

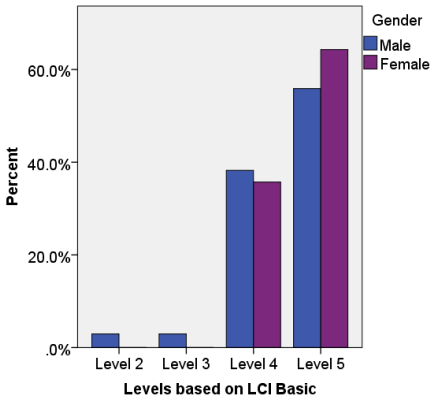


Figure 4.36. LCI Basic score category by gender

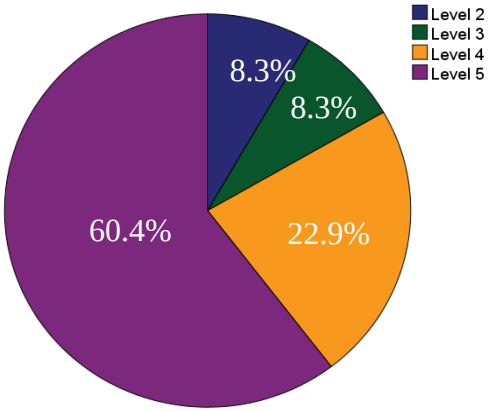


Figure 4.37. Physical functioning level based on LCI Advanced score

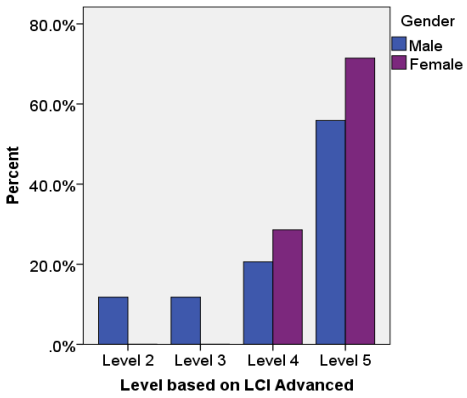


Figure 4.38. LCI Advance score category by gender

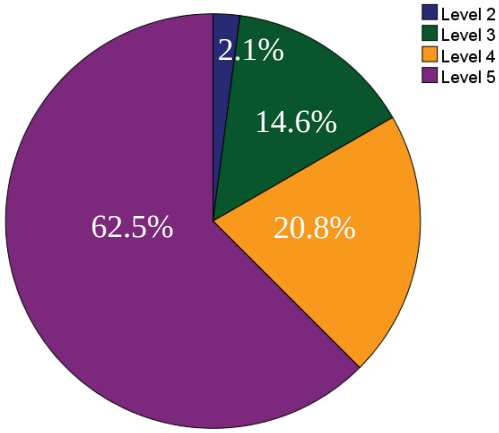


Figure 4. 39. Physical functioning level based on LCI Total score

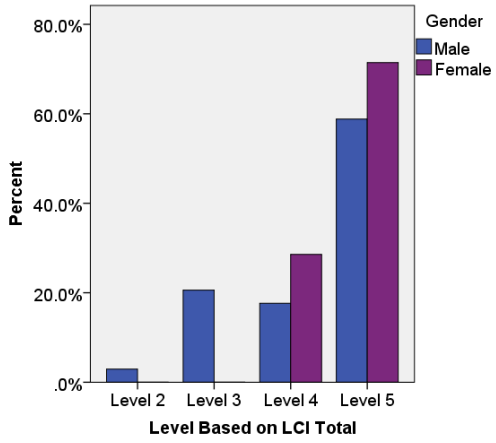


Figure 4.40. LCI Total score category by gender

4.3. Analysis of Cardiorespiratory Functioning

Cardiorespiratory function was analyzed based on 6MWT and lung function test results.

4.3.1. Analysis of Six Minute Walk Test

6MWD, VO_2max derived using 6MWD, and basic parameters measured before and after the 6MWT were analyzed. Mean, SD, minimum and maximum like descriptive analysis was performed since the data is normally distributed.

According to the descriptive statistics of Table 4.9, there is no much deviation of basic parameters measure at 6MWT between the genders. Nevertheless, there is a much deviation of 6MWD and VO_2max between genders and males are having higher average of those values comparatively to the females. In addition to that there is a significant negative moderate correlation between VO_2max, and Systolic BP rest, Diastolic BP rest and Borg's scale respectively and there is no significant correlation between 6MWD and other basic parameters of 6MWT(Table 4.10).

Table 4.9. Descriptive statistics of six minute walk test

Variable	**Female (n=14) (29.2%)**		**Male (n=34) (70.8%)**	
	Mean ± SD	Range	Mean ± SD	Range
6MWD (m)	280.50 ± 80.154	160-486	358.15 ± 121.501	105-567
VO_2max (ml/kg/min)	32.52 ± 5.041	26.6-46	38.33 ± 6.533	23.14-50.72
Systolic BP at rest (mmHg)	131.64 ± 6.246	118-142	128.38 ± 9.182	107-142
Systolic BP at end (mmHg)	137.71 ± 9.084	121-151	138.15 ± 14.604	104 -166
Diastolic BP at rest (mmHg)	85.64 ± 7.479	69-98	80.38 ± 8.944	60-100
Diastolic BP at end (mmHg)	88.79 ± 8.414	67-102	83.44 ± 8.621	64-100
HR at rest (beats/min)	76.43 ± 6.836	65-88	75.79 ± 11.911	52 -105
HR at end (beats/min)	85.14 ± 8.338	69-102	93.15 ± 18.673	61 -137
SpO_2 at rest (mmHg)	97.64 ± 1.082	95-99	97.53 ± 1.022	95 -99
SpO_2 at end (mmHg)	96.50 ± 1.345	93-98	96.79 ± 1.409	92- 99
Borg's scale	13.21 ± 1.528	11-17	12.71 ± 1.784	9 -18

6MWD- Six minute walk distance, BP- Blood Pressure, HR- Heart Rate, SpO_2- Oxygen saturation level in blood, n- number of participants, SD- Standard Deviation,

Table 4.10. Correlation between cardiorespiratory functions and its parameters

Variables	Level of correlation	p value
6MWD ~ Systolic BP rest	-0.284	0.051
6MWD ~ Diastolic BP rest	-0.240	0.100
6MWD ~ HR rest	-0.192	0.191
6MWD ~ SpO_2 rest	0.141	0.341
6MWD ~ Borg's scale	-0.235	0.107
VO_2 max ~ Systolic BP rest	-0.563	0.000*
VO2 max ~ Diastolic BP rest	-0.533	0.000*
VO2 max ~ SpO_2 rest	-0.259	0.076
VO2 max ~ Borg's scale	-0.364	0.011*

6MWD- Six minute walk distance, VO_2max- Maximum Oxygen consumption, *- variables with significance difference, at 5% significant level

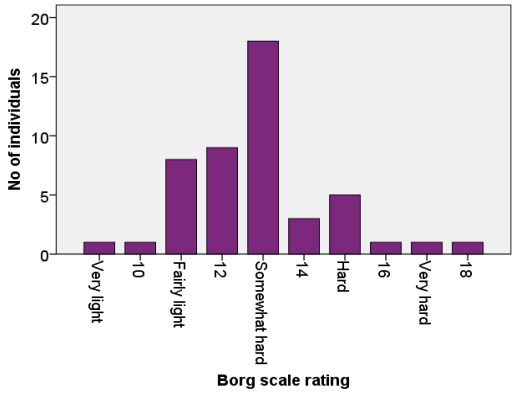


Figure 4.41. Borg scale responses at the end of 6MWT

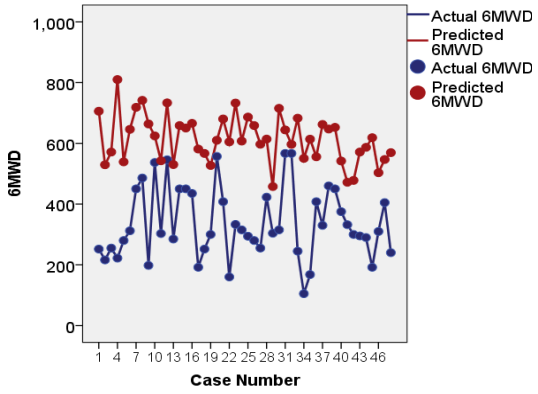


Figure 4.42. Fluctuation of 6MWD with individuals predicted distance

Figure 4.41 shows the perceive level of exertion measures at the end of the 6MWT using Borgs scale and results show that maximum number of individuals 37.5% (n=18) presented with somewhat hard exertion level. Further, it shows that 77% of individuals are having Borgs scale rating less than 14 which means relatively low level of exertion. None of the individuals had achieved their predicted distance at the end of the 6MWT which is not show a good picture about their cardiorespiratory endurance (Figure 4.42).

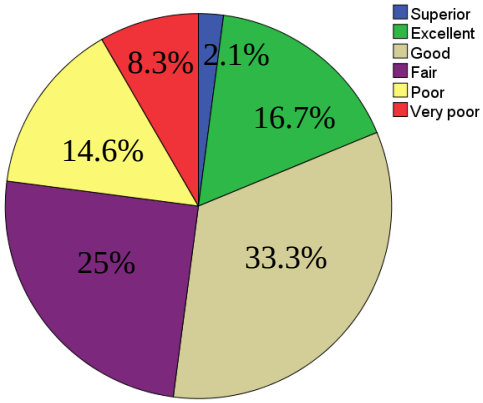


Figure 4.43. VO_2max level calculated after 6MWT

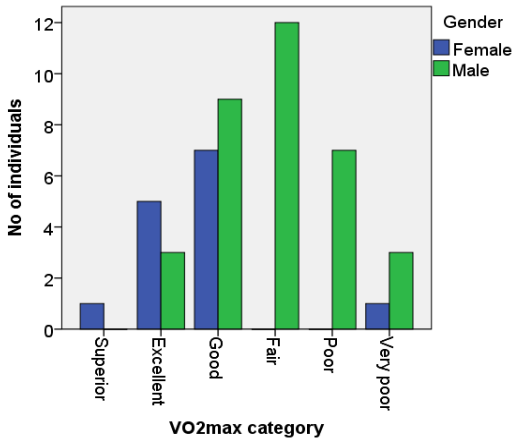


Figure 4.44. VO_2max level by gender

VO_2max was calculated using 6MWD and found that 52% of individuals have good and above level of VO_2max where it shows satisfactory level of cardiorespiratory endurance. Further, result shows that 23% of individuals have poor and below level of cardiorespiratory endurance (Figure 4.43). Moreover, Most of the female have good and above level while most of the male have faire and below level of cardiorespiratory endurance (Figure 4.44).

4.3.2. Analysis of Spirometry

Respiratory functions were assessed using spirometry and the Table 4.11 shows the deviations of lung functions over age categories. According to the table mean values of all the parameters are decreasing with aging which is normal due to physiological changes of lungs with aging.

Table 4.11. Descriptive statistics of spirometry

Variable	**20-35 (N=11)**		**36-45 (N=15)**		**46-60 (N=22)**	
	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	Range
FVC ((L)	3.26 ±0.85	1.81-4.80	2.73 ±0.67	1.50 - 3.85	2.29 ±0.41	1.66 - 3.15
FEV1 (L)	2.88 ±0.76	1.66 - 4.19	2.40 ± 0.61	1.30 - 3.49	2.08 ±0.38	1.53 - 2.83
FEV1/FVC%	88.00 ±5.74	81.00 - 99.00	88.70 ±6.47	78.50 - 97.80	90.25 ±6.24	73.50 - 100.00
PEFR (L/Sec)	6.57 ±1.39	4.20 - 8.21	5.97 ±1.93	2.75 - 8.86	4.94 ±1.44	2.69 - 9.16

FVC- Forced Vital Capacity, FEV1- Forced Expiratory Volume in 1 second, PEFR- Peak Expiratory Floor Rate, n- number of participants, SD- Standard Deviation,

The descriptive statistics shows that 31.3% of participants have restrictive respiratory pattern where 68.8% have normal respiratory functions which defined bases on the spirometry test results (Figure 4.51). Moreover results show that female percentage of restrictive respiratory pattern is higher than male percentage (Figure 4.52).

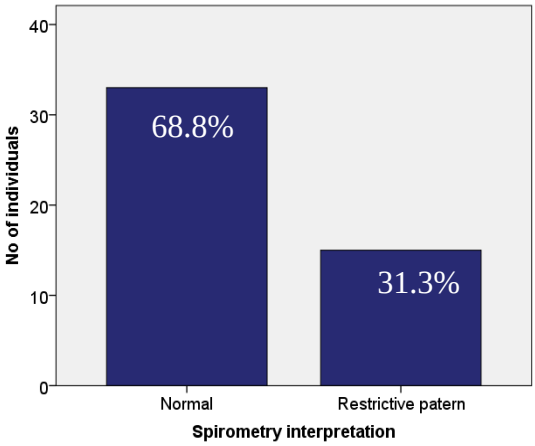


Figure 4.45. Respiratory pattern based on spirometry data

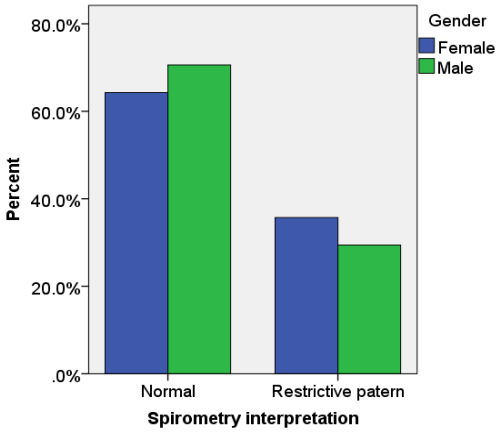


Figure 4.46. Respiratory pattern by gender

4.4. Effect of Sociodemographic and Amputation Status on Physical and Cardiorespiratory Functions

Variation of physical and cardiorespiratory functions in relation to sociodemographic data such as age, level of education, previous occupation status, job engagement and income, and amputation status and prosthetic usage data; Level of amputation, Phantom pain, duration of amputation, duration of rehabilitation, walking hours per day were analyzed. Table 4.12 and 4.13, represent the correlation between age, and physical and cardiorespiratory functions, and results shows that LCI depends on height but not on age, weight and BMI. Further shows that FVC depends on age, height and weight but not on BMI. 6MWD depends on age but not on height, weight and BMI. VO_2max depends on age, weigh and BMI not on height. There is no significant correlation of age, height, weight and BMI with physical functioning.

Table 4.12. Correlation between age, height, weight and BMI on physical functioning

Variables	Pearson correlation value	p value
Age ~ AMPPRO	-0.157	0.288
Age ~ LCI Total	-0.094	0.527
Height ~ AMPPRO	-0.192	0.190
Height ~ LCI Total	-0.366	0.010*
Weight ~ AMPPRO	-0.147	0.319
Weight ~ LCI Total	-0.179	0.223
BMI ~ AMPPRO	-0.115	0.437
BMI ~ LCI Total	0.005	0.971

AMPPRO- Amputee Mobility Predictor with Prosthesis, LCI- Locomotor Capability Index, BMI- Body Mass Index, *- variables with significance difference, at 5% significant level

Table 4.13. Correlation between age, height, weight and BMI on cardiorespiratory functions

Variables	Pearson correlation value	p value
Age ~ FVC	-0.548	0.000*
Age ~ 6MWD	-0.399	0.005*
Age ~ VO_2max	-0.605	0.000*
Height ~ FVC	0.682	0.000*
Height ~ 6MWD	0.107	0.468
Height ~ VO_2max	0.175	0.235
Weight ~ FVC	0.359	0.012*
Weight ~ 6MWD	0.021	0.886
Weight ~ VO_2max	-0.310	0.032*
BMI ~ FVC	0.021	0.888
BMI ~ 6MWD	-0.043	0.772
BMI ~ VO_2max	-0.459	0.001*

FVC- Forced Vital Capacity, 6MWD- Six Minute Walk Distance, VO_2max- Maximum Oxygen Consumption, BMI- Body Mass Index, *- variables with significance difference, at 5% significant level

Table 4.14. Correlation between sociodemographic and amputation Status on physical functions

Variables	Spearman's rank correlation value	p value
Income ~ AMPPRO	0.143	0.332
Income ~ LCI Total	0.160	0.279
Time since amputation ~ AMPPRO	0.221	0.131
Time since amputation ~ LCI	0.434	0.002*
Duration of rehabilitation ~ AMPPRO	0.119	0.419
Duration of rehabilitation ~ LCI	0.097	0.511
Mobility hours per day ~ AMPPRO	0.269	0.064
Mobility hours per day ~ LCI	0.314	0.030*
Mobility hours per day with the prosthesis ~ AMPPRO	0.464	0.001*
Mobility hours per day with the prosthesis ~ LCI	0.538	0.000*

AMPPRO- Amputee Mobility Predictor, LCI- Locomotor Capability Index, *- variables with significance difference, at 5% significant level

The results show that there is significant positive association between income, and 6MWD and VO_2max respectively. In addition to that there is significant positive correlation among duration since amputation and LCI as well as duration of amputation and 6MWD. Further, significant positive correlation was found duration of rehabilitation to 6MWD, mobility hours per day with the prosthesis to physical functioning as well as to 6MWD and Mobility hours per day to LCI (Table 4.14 and 4.15).

Table 4.15. Correlation between sociodemographic and amputation status on cardiorespiratory Functions

Variables	Spearman's rank correlation value	p value
Income ~ FVC	0.123	0.404
Income ~ 6MWD	0.463	0.001*
Income ~ VO_2max	0.365	0.011*
Time since amputation ~ 6MWD	0.309	0.033*
Time since amputation ~ VO_2max	-0.038	0.799
Duration of rehabilitation ~ FVC	0.139	0.346
Duration of rehabilitation ~ 6MWD	0.307	0.034*
Duration of rehabilitation ~ VO_2max	0.129	0.383
Mobility hours per day ~ FVC	0.004	0.979
Mobility hours per day ~ 6MWD	0.198	0.177
Mobility hours per day ~ VO_2max	0.115	0.435
Mobility hours per day with the prosthesis ~ FVC	0.008	0.956
Mobility hours per day with the prosthesis ~ 6MWD	0.309	0.032*
Mobility hours per day with the prosthesis ~ VO_2max	0.144	0.33

FVC- Forced Vital Capacity, 6MWD- Six Minute Walk Distance, VO_2max- Maximum Oxygen Consumption, *- variables with significance difference, at 5% significant level

According to the Table 4.16, physical functional level significantly depends on the level of amputation while gender, job engagement, previous occupation status and phantom pain do not exists such significant on levels of physical functioning. Further, results show that below knee amputation patients have higher physical functioning comparatively to above knee amputation patients. Respiratory functions and cardiorespiratory endurance is significantly depend on the gender and job engagement. In addition to that, 6MWD significantly depends on previous occupation status and level of amputation. Further shows that male have higher 6MWD than

female and below knee amputation patients have higher 6MWD than above knee amputation individuals (Table 4.17).

Table 4.16. Comparison between sociodemographic and amputation status, and physical Functions

Testing variable	**Grouping variable (n)**		**Mean ± SD**	**Independent sample t test (p value)**
AMPPRO	Gender	Male (34)	37.29 ± 9.86	0.251
		Female (14)	40.29 ± 7.19	
	Job engagement	Yes (26)	39.38 ± 9.96	0.324
		No (22)	41.77 ± 6.09	
	Previous occupation status	Civil (39)	38.18 ± 9.24	0.984
		Army (9)	38.11 ± 9.53	
	Level of amputation	AK (15)	26.93 ± 6.65	0.000*
		BK (33)	43.27 ± 4.33	
	Phantom pain	Present (33)	37.36 ± 9.72	0.375
		Absent (15)	39.93 ± 7.94	
LCI	Gender	Male (34)	46.50 ± 11.33	0.076
		Female (14)	51.36 ± 6.812	
	Job engagement	Yes (26)	49.88 ± 9.71	0.160
		No (22)	45.59 ± 10.90	
	Previous occupation status	Civil (39)	47.44 ± 11	0.405
		Army (9)	50 ± 7.3	
	Level of amputation	AK (15)	38.13 ± 7.59	0.000*
		BK (33)	52.36 ± 8.25	
	Phantom pain	Present (33)	47.55 ± 9.98	0.734
		Absent (15)	48.73 ± 11.55	

AMPPRO- Amputee Mobility Predictor, LCI- Locomotor Capability Index, AK- Above knee, BK- Below knee, n- number of participants, SD- Standard deviation, *- variables with significance difference, at 5% significant level

Table 4.17. Comparison between sociodemographic and amputation status, and cardiorespiratory functions

Testing variable	Grouping variable (n)		Mean ± SD	Independent sample t test (p value)
FVC	Gender	Male (34)	2.93 ± 0.65	0.000*
		Female (14)	1.96 ± 0.21	
	Job engagement	Yes (26)	3.36 ± 0.54	0.039*
		No (22)	2.95 ± 0.76	
	Previous occupation status	Civil (39)	2.60 ± 0.75	0.253
		Army (9)	2.86 ± 0.54	
	Level of amputation	AK (15)	2.68 ± 0.55	0.795
		BK (33)	2.63 ± 0.79	
	Phantom pain	Present (33)	2.67 ± 0.62	0.736
		Absent (15)	2.59 ± 0.91	
6MWD	Gender	Male (34)	358.15 ± 121.50	0.013*
		Female (14)	280.50 ± 80.15	
	Job engagement	Yes (26)	377.42 ± 106.62	0.005*
		No (22)	282.95 ± 108.36	
	Previous occupation status	Civil (39)	314.92 ± 110.36	0.012*
		Army (9)	424.67 ± 99.75)	
	Level of amputation	AK (15)	267.40 ± 79.36	0.001*
		BK (33)	366.45 ± 117.41	
	Phantom pain	Present (33)	338.21 ± 118.29	0.811
		Absent (15)	329.53 ± 113.99	
VO_2max	Gender	Male (34)	38.33 ± 6.53	0.002*
		Female (14)	31.52 ± 5.04	
	Job engagement	Yes (26)	39.69 ± 6.73	0.000*
		No (22)	33.03 ± 4.43	
	Previous occupation status	Civil (39)	35.82 ± 6.59	0.075
		Army (9)	40.17 ± 5.97	
	Level of amputation	AK (15)	34.11 ± 5.96	0.066
		BK (33)	37.78 ± 6.70	
	Phantom pain	Present (33)	36.99 ± 6.91	0.573
		Absent (15)	35.85 ± 6.17	

FVC- Forced Vital Capacity, 6MWD- Six Minute Walk Distance, VO_2max- Maximum Oxygen Consumption, AK- Above knee, BK- Below knee, n- number of participants, SD- Standard deviation, *- variables with significance difference, at 5% significant level

Table 4.18. Comparison between education level, and physical and cardiorespiratory functions

Testing variable	**Grouping variable; Education level (Mean (SD))**					**ANOVA test (p value)**
	Primary (n=13)	Secondary - Basic (n=4)	Secondary - Ordinary (n=14)	Secondary - Advance (n=11)	Higher education (n=6)	
AMPPRO	36.08 ± 8.44	33.75 ± 13.35	37.86 ± 9.90	41.18 ± 7.92	40.83 ± 8.98	0.525
LCI	46.62 ± 10.41	42.75 ± 15.31	48.93 ± 8.16	49.45 ± 11.63	49 ± 11.56	0.817
FVC	2.49 ± 0.76	3.16 ± 0.52	2.60 ± 0.54	2.87 ± 0.94	2.35 ± 0.49	0.314
6MWD	264.54 ± 91.64	351.75 ± 92.22	369.86 ± 124.99	389.45 ± 119.14	299.33 ± 85.10	0.059
VO_2max	34.06 ± 6.21	40.83 ± 5.09	37.01 ± 5.52	39.98 ± 6.94	32.43 ± 7.34	0.059

AMPPRO- Amputee Mobility Predictor, LCI- Locomotor Capability Index, FVC- Forced Vital Capacity, 6MWD- Six Minute Walk Distance, VO_2max- Maximum Oxygen Consumption, n= number of participants, SD- Standard Deviation, *- variables with significance difference, at 5% significant level

According to the results shows in Table 4.18, education level of the participants don't have significant dependency on physical or cardiorespiratory functioning. Table 4.19 shows that prosthetic usage significantly affects on physical functioning but not on cardiorespiratory functions and physical functioning is higher among the always prosthesis usage group while lowest among rarely usage group. There is significance difference between "always usage" and "usually usage", "rarely usage" respectively relation to AMPPRO and between "always usage" and "rarely usage" and between "usually usage" and "rarely usage" relation to LCI based on Scheffe method with the Bonferroni correction at 5% significant level (Table 4.20).

Table 4.19. Comparison between prosthetic usage, and physical and cardiorespiratory functions

Testing variable	**Grouping variable; Prosthetic usage (Mean ± SD)**			**ANOVA test (p value)**
	Always (n=22)	Usually (n=7)	Rarely (n=4)	
AMPPRO	41.65 ± 6.89	32.13 ± 9.85	26.50 ± 6.41	0.000*
LCI	51.74 ± 7.22	44.38 ± 10.13	31 ± 8	0.000*
FVC	2.62 ± 0.72	2.5 ± 0.38	3.01 ± 0.97	0.384
6MWD	349.12 ± 111.09	349.75 ± 146.86	239.33 ± 41.98	0.092
VO_2max	36.95 ± 6.89	35.60 ± 7.33	36.22 ± 6.64	0.868

AMPPRO- Amputee Mobility Predictor, LCI- Locomotor Capability Index, FVC- Forced Vital Capacity, 6MWD- Six Minute Walk Distance, VO_2max- Maximum Oxygen Consumption, n= number of participants, SD- Standard Deviation, *- variables with significance difference, at 5% significant level

Table 4.20. Between groups comparison of prosthesis usage relation to AMPPRO and LCI

Testing variable	**Prosthetic usage**		**Scheffe method (p value)**
	Usage	**Usage**	
AMPPRO	Always	Usually	0.008*
		Rarely	0.000*
	Usually	Rarely	0.378
LCI	Always	Usually	0.068
		Rarely	0.000*
	Usually	Rarely	0.011*

AMPPRO- Amputee Mobility Predictor, LCI- Locomotor Capability Index, *- variables with significance difference, at 5% significant level

Table 4.21. Comparison between prosthetic usage satisfaction, and physical and cardiorespiratory functions

Testing variable	**Grouping variable; Prosthetic usage satisfaction (Mean ± SD)**			**ANOVA test (p value)**
	High (n=33)	Moderate (n=7)	Low (n=8)	
AMPPRO	42.91 ± 5.47	31.14 ± 7.22	24.75 ± 5.01	0.000*
LCI	52.24 ± 8.61	42.71 ± 7.67	34.63 ± 4.24	0.000*
FVC	2.63 ± 0.80	2.83 ± 0.59	2.54 ± 0.37	0.736
6MWD	358.91 ± 112.25	327.43 ± 118.81	246 ± 92.51	0.042*
VO_2max	37.07 ± 7.10	37.07 ± 4.74	34.46 ± 6.32	0.607

AMPPRO- Amputee Mobility Predictor, LCI- Locomotor Capability Index, FVC- Forced Vital Capacity, 6MWD- Six Minute Walk Distance, VO_2max- Maximum Oxygen Consumption, n= number of participants, SD- Standard Deviation, *- variables with significance difference, at 5% significant level

Table 4.22. Between groups comparison of prosthesis usage satisfaction relation to AMPPRO, LCI and 6MWD

Testing variable	**Prosthetic usage satisfaction**		**Scheffe method (p value)**
	Satisfaction	**Satisfaction**	
AMPPRO	High	Moderate	0.000*
		Low	0.000*
	Moderate	Low	0.105
LCI	High	Moderate	0.022
		Low	0.000*
	Moderate	Low	0.157
6MWD	High	Moderate	0.791
		Low	0.043*
	Moderate	Low	0.37

AMPPRO- Amputee Mobility Predictor, LCI- Locomotor Capability Index, 6MWD- Six Minute Walk Distance, *- variables with significance difference, at 5% significant level

Table 4.21 shows that prosthetic usage satisfaction significantly affects on physical functioning and 6MWD. Physical functioning and 6MWD is higher in the high prosthesis usage satisfaction group while lowest among low usage satisfaction group. There is significance difference between “high satisfaction” and “moderate

satisfaction", "low satisfaction" respectively relation to AMPPRO and between "high satisfaction" and "low satisfaction" relation to LCI and 6MWD based on Scheffe method with the Bonferroni correction at 5% significant level (Table 4.22).

4.5. Association between Physical and Cardiorespiratory Functions

Table 4.23. Dependency between physical functions and cardiorespiratory functions

Variables	Chi squared value	p value
AMPPRO ~ Spirometry	1.989	0.575
LCI basic ~ Spirometry	5.37	0.147
LCI Advanced ~ Spirometry	2.443	0.486
LCI Total ~ Spirometry	1.543	0.672

AMPPRO- Amputee Mobility Predictor, LCI- Locomotor Capability Index, *- variables with significance difference, at 5% significant level

The table 4.23 shows that there is no significant dependency among physical functional level and respiratory pattern. Further, it is found that, there is significant association among physical functioning and cardiorespiratory endurance (Table 4.24).

Table 4.24. Correlation between physical functions and cardiorespiratory functions

Variables	Pearson correlation value	p value
AMPPRO ~ 6MWD	0.572	0.000*
AMPPRO ~ VO_2max	0.357	0.013*
AMPPRO ~ FVC	0.025	0.864
LCI basic ~ 6MWD	0.560	0.000*
LCI advanced ~ 6MWD	0.506	0.000*
LCI Total ~ 6MWD	0.545	0.000*
LCI basic ~ VO2max	0.315	0.029*
LCI Advanced ~ VO2max	0.262	0.072
LCI Total ~ VO_2max	0.292	0.044*
LCI basic ~ FVC	-0.029	0.847
LCI advanced ~ FVC	-0.098	0.507
LCI Total ~ FVC	-0.111	0.453

AMPPRO- Amputee Mobility Predictor, LCI- Locomotor Capability Index, FVC- Forced Vital Capacity, 6MWD- Six Minute Walk Distance, VO_2max- Maximum Oxygen Consumption, *- variables with significance difference, at 5% significant level

Table 4.25. Comparison between AMPPRO and cardiorespiratory functions

Testing variable	**Grouping variable; AMPPRO level (Mean ± SD)**				**ANOVA test (p value)**
	K1 (n=8)	K2 (n=9)	K3 (n=8)	K4 (n=23)	
6MWD	251.75 ± 51.62	274.89 ± 92.88	249.75 ± 54.60	418.17 ± 99.09	0.000*
VO_2max	33.16 ± 6.53	36.02 ± 5.07	32.41 ± 3.36	39.55 ± 6.91	0.014*

6MWD- Six Minute Walk Distance, VO_2max- Maximum Oxygen Consumption, n= number of participants, SD- Standard Deviation, *- variables with significance difference, at 5% significant level

There are significance differences between K levels in relation to 6MWD and VO_2max based on ANOVA test results (Table 4.25). Further found that there is significance difference only between K4 level and K1, K2, K3 respectively relation to 6MWD and between K4 and K3 relation to VO_2max based on Scheffe method with the Bonferroni correction at 5% significant level (Table 4.26).

Table 4.26. Between groups comparison of AMPPRO relation to 6MWD and VO_2max

Testing variable	**AMPPRO level**		**Scheffe method (p value)**
	K level	**K level**	
6MWD	K1	K2	0.958
		K3	1.000
		K4	0.000*
	K2	K3	0.947
		K4	0.002*
	K3	K4	0.000*
VO_2max	K1	K2	1.000
		K3	1.000
		K4	0.88
	K2	K3	1.000
		K4	0.85
	K3	K4	0.39*

AMPPRO- Amputee Mobility Predictor with Prosthesis, 6MWD- Six Minute Walk Distance, VO_2max- Maximum Oxygen Consumption, *- variables with significance difference, at 5% significant level

4.6. Patterns of Functional Level through Cluster Analysis

Cluster analysis was performed to identify the pattern of variation of overall functioning level of each participant. Outcome measures of AMPPRO, LCI, 6MWD and VO_2max which represent physical and cardiorespiratory functions of individuals were used to identify those patterns. Analysis was carried out using both complete and average linkage methods and results shows that individuals can be divided in to three different clusters based on their overall functioning (Figure 4.53 and 4.54).

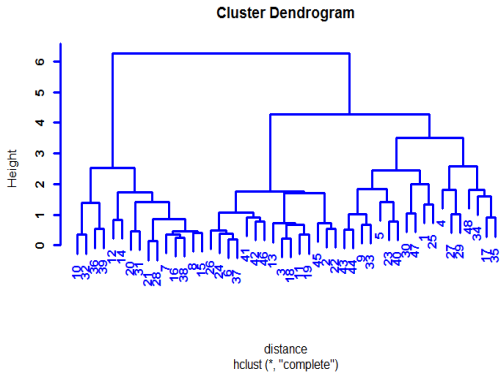


Figure 4.47. Dendrogram using Complete Linkage method

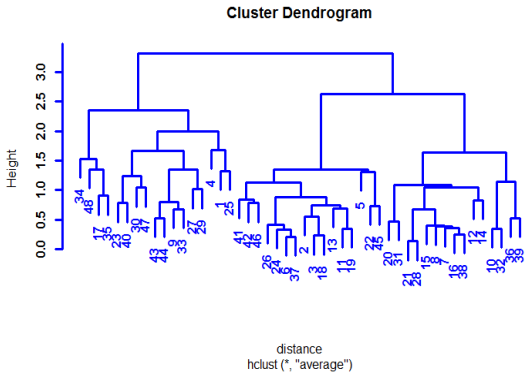


Figure 4.48. Dendrogram using Average Linkage method

Number of clusters can be confirmed as three based on the silhouette plot and within group SS plot (Figure 4.55 and 4.56). Silhouette plot shows three clusters with average width of 0.45 and very closer lines within each cluster which represents difference between each cluster is higher and functional level of each individuals within the cluster is very much similar. Within group SS plot shows there is larger gap between first three clusters and gap is reduced when number of clusters are increased. Hence, three clusters are the ideal for identifying the pattern of functional level of participants.

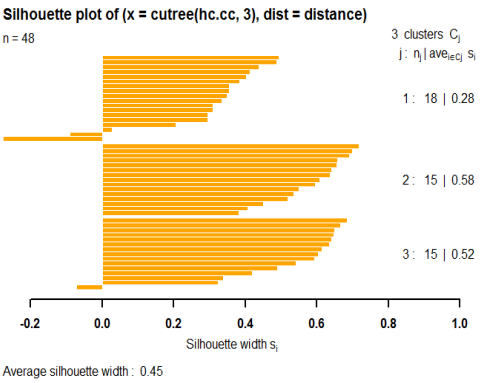


Figure 4.49. Silhouette plot

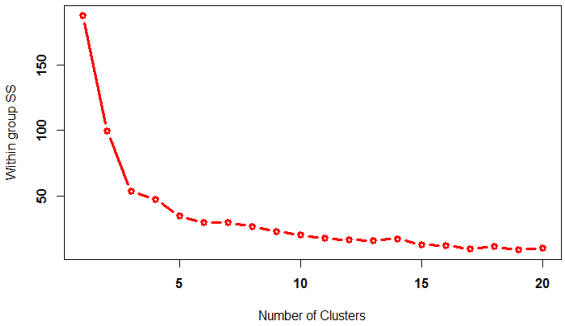


Figure 4.50. Within group SS plot

According to hierarchical clustering with complete linkage and average linkage individuals groups in to three clusters as follows in Table 4.27. According to the table individual allocation in to clusters quite similar expect one individual.

Table 4.27. Clustering of individual into three clusters

	Complete Linkage method			
Average Linkage method	**Cluster**	**1**	**2**	**3**
	1	17	0	0
	2	1	15	0
	3	0	0	15

Mean Z values for each groups were calculated in respect to four variable; AMPPRO, LCI, 6MWD and VO_2max and found that mean values between the groups are different for all four variables. Hence, the results conclude that all these variables has being encountered equally when develop three clusters and these three clusters shows individuals with low, moderate and high functional outcomes respectively (Table 4.28).

Table 4.28. Mean based on Z values for outcome variables and three categories of functional outcomes

Cluster	Category		AMPPRO	LCI	6MWD	VO_2max
1	Low	Z value	-1.148124	-1.136475	-0.609662	-0.316383
		Range	17-39	18-45	105-405	23.14-44.1
2	Moderate	Z value	0.518468	0.598454	-0.512577	-0.644795
		Range	39-44	49-56	160-332	26.6-37.55
3	High	Z value	0.859280	0.765315	1.244172	1.024456
		Range	44-47	54-56	408-567	35.13-50.7

AMPPRO- Amputee Mobility Predictor, LCI- Locomotor Capability Index, 6MWD- Six Minute Walk Distance, VO_2max- Maximum Oxygen Consumption

Table 4.29. Relationship of categories of functions with gender and previous occupational status

Variables	Chi squared value	p value
Functional categories ~ gender	10.998	0.004*
Functional categories ~ previous occupational status	5.698	0.05*

*- variables with significance difference, at 5% significant level

Overall functional level of the participants are categorized into three categories based on the cluster analysis and those categories were compared with gender and previous job category of the participants. The results show that there is a significant impact of gender and previous job category of the participants on three categories of functional outcomes ($P \leq 0.05$) (Table 4.29). Table 4.30 and 4.31 shows that male and army job category have higher functional levels comparatively to female and civil job categories.

Table 4.30. Gender and functional categories cross tabulation

		Functional categories			Total
		Low	Moderate	Good	
Gender	Male	14	6	14	34
	Female	4	9	1	14
Total		18	15	15	48

Table 4.31. Previous job category and functional categories cross tabulation

		Functional level category			Total
		low	moderate	good	
previous job category	civil	14	15	10	39
	army	4	0	5	9
Total		18	15	15	48

4.7. Qualitative Analysis

Recorded face to face interviews were analyzed based on the steps of content analysis to determine the quality of basic management and rehabilitation guidance, level of satisfaction, and barriers of patients with unilateral lower limb amputation. Basic management and rehabilitation guidance was redirected to different area when exploring patient's ideas. Those are surgical and wound care advices, nutritional advices, hygienic advices, basic exercises and guidance to rehabilitation centres for prosthetic fitting and those details are presented in the Table 4.30.

Table 4.32. Outline of basic management and rehabilitation guidance of participants

Basic management and rehabilitation guidance received	**Number of participants**
Basic management + all the advices + rehabilitation guidance	7
Basic management + all the advices + no rehabilitation guidance	3
Basic management only + no advices + no rehabilitation guidance	5
Basic management + exercises + rehabilitation guidance + no any other advices	2
Basic management + all the advices except nutritional + rehabilitation guidance	2

All the participants stated that clear explanations and advices are given before and after the surgery as well as for wound dressing and caring by hospital staff like surgeons and nurses. They responded when asking about wound dressing and caring *"It is in normal way, teach how to do washing and bandaging and all, no more*

specific things (patient 09)" and *"Good, very good, give good support. Everything was given and took care (Patient 15)"*. Among them, ten participants claimed that they received further advices on nutritional requirements, weight control, and maintenance of proper hygiene by nursing staff and exercise regime by physiotherapists and claimed like "*yes yes, Dr. said that have good food and be careful in developing diabetic and continue exercises (patient 10)*". Two of them state that further advices were given on maintenance of proper hygiene by nursing staff and exercise regime but not on nutritional requirements and weight control and claimed as *"give most of the advices and thing but not tell about how to do dieting (patient 14)"*. Three of them claimed that they received further advices on exercise regime but no advices received on nutritional requirements, weight control, and maintenance of proper hygiene and claimed as *"Nothing much about food and all but gave other advices like do exercises like this like this all (patient 14)".* It was found that though they received basic management, only eight of them were guided for further rehabilitation and prosthetic fitting from the hospital while others directed for rehabilitation and prosthetic fitting by themselves. Moreover, results reflects that, all the six participants who received management from the forces hospitals while only two out of fourteen those who received basic management from government hospitals are directly guided for rehabilitation centres.

Eighteen participants have received rehabilitation and prosthesis from rehabilitation centres while two of them got the prosthesis by their own without rehabilitation. Rehabilitation centres provide further advices and continue rehabilitation until patient would be able walking with the prosthesis without falling only. The rehabilitation mainly focus on stump conditioning, strengthening, prosthetic fitting and finally walking with the prosthesis. Hereafter, participants are engage in their daily living activities and revisit the rehabilitation centre for the modifications of the prosthesis only. None of the participants were reassess and guided to continue the exercises in advance manner in order to improve muscular strengthening, muscular and cardiorespiratory endurance as well as their quality of life. Nevertheless, all most all the participants were satisfied about the management, caring and hospitality that they received from hospitals and rehabilitation centres.

According to the data received, level of satisfaction was subdivided as satisfaction on services received from hospitals and rehabilitation centres, satisfaction about the level now participants are after amputation and satisfaction about the

support received from family, friends and the society. Four of them have went through depression after amputation but now most of them are trying to adapt to the situation and being independent as much as possible and claimed that *"Disappointed about at the beginning, but later understood somehow I have to live, my family support me a lot to come back (patient 8)"*. All most all of them are quite satisfied and accepted the life that they received after injury and claimed that *"Now I am not thinking about that much. Have a good way of income know. So now it is fine (patient 01)"* and *"now have more respect even than previous and I have my own business. I am well satisfied now (patient 13)"*. All of them are well satisfied about the help received from their families and friends and claimed that *"No words to say, they help me a lot. Now even my wife not allow me to go out alone (patient 16)"* and *"Generally everyone help me. My wife got retired to help me. Now even caring so much (patient 20)"*. Nevertheless, majority not satisfied about the support that they receive from the society and claimed that *"If I tell truth, I am disappointed. When go to help in public things they just ignore us (patient 04)"* and *"The fact is people are not respecting and ask for the work like previous. That makes me more sad (patient 11)"*. Three of them are telling that society try to sympathetic rather than empathic *"They welcome us but some are just empathic and tell poor one have lost one leg at the war. So have to help like. But have to accept that (patient 06)"* that they do not interest while one claimed that they received respect from the society than previous. Some of them are not got satisfactory service like guidance for rehabilitation, donations, guidance for employments from the social service officers from their areas and claimed that *"Actually no one came to see from the divisional secretariat area, no one informed even that we can have disability allowance and other loans for self-employment. Today only heard something like that (patient 11)"*. Very few of them are express that religious support is not satisfied after amputation *"Even Imam of the mosque in our area came to see me and did support but as a Buddhist, Monk in our temple until today did not ask any word or did nothing. Really sad about that (patient 18)"*.

Barriers were categorized in to physical barriers, economical barriers, attitudinal barriers and barriers on rules and regulations, based on the information received from participants. Most of them are adapted to the life that they have and not seen some physical barriers as barriers to their life and claimed that *"there are enough buses in the road and most of the time I used my three wheel to go outside. So do not*

have any special difficulties (patient 01)". Most of them are have ability to provide transportation by their own. Hence, problems in accessibility to public transportation do not recognize as a barrier for them. Nevertheless, very few of them are having physical barriers such as hilly area, less number of public transportation, inadequate water supply and claimed that *"there is no proper road to the house, have to walk lot to the bus stop and water supply also not there. Go to other houses asking for water (patient 2)"*. Further, most of them claimed that tiled floors, stairs of offices as well as hospitals is barrier them to attend in their personal work or clinics and claimed that *"When go to hospital clinic, it is difficult to walk in the tilled floor. I have fallen even (patient 13)"*.

All the participants who retired from the forces have good enough pension to maintain better economical states claimed that *"Now I have the pension after retired from the police after the injury and wife also have a job. So no money problem actually (Patient 17)"*. Nevertheless, most of the civil participants have economic problems which they consider as a barrier to engage in proper rehabilitation as well as to maintain good standard of life and claimed that *"No any other special problem to say but the economic problem at home only (patient 05)"*. In addition to that, most of the participants claimed that low attitudes of the society is one of the main barrier that makes them distract from engage in social activities and claimed that *"People are thinking that now this person is disable so we do not want him anymore. This makes me not to participate anything outside (patient 11)"*. Further, they claimed that improper rules and regulations of the government they cannot engage in daily activities in an effective manner though the government lounge a special identity card for people with disabilities.

Chapter V
DISCUSSION AND CONCLUSION

In the present study, the socio-demographical and amputation status of a sample of 48 unilateral amputation patients are studied in order to find mutual associations and associations to physical and cardiorespiratory functions those who engaged in rehabilitation and prosthetic fitting.

5.1. Variation of Socio-demographical, Amputation Status and Rehabilitation Aspects

Sociodemographic information such as age, gender, income, marital status, education, previous and current job engagement of patient who are engaged in rehabilitation after unilateral lower limb amputation was analyzed in this study. Though there are participants who is around 60 years old, study directly cannot claimed that even older aged people in Sri Lanka is engaging in rehabilitation because most of our participants has went through the amputation and rehabilitation before long years back.

The study also found that 81% of participants have partners and most of them are got injured after their marriage. Sri Lanka is having a culture where family and the marriage take a most important place and people are bound to their family to been together as well as to help each other even in problematic situations. Qualitative analysis also found that they are receiving higher level of family support which make good environment to make them engage in rehabilitation, and prosthetic fitting as well to have good satisfactory level of life after amputation.

Sri Lanka is a country with more than 90% of literacy rate as well as government have well planned primary, secondary and higher education system. This is free education system and it is a must to enter the children into school education according to legislations. According to the study findings, more than 60% of them have educated up to secondary ordinary, and above levels and that can be considered as individual have good level of education. Similarly Amtmann, Morgan, Kim, & Hafner (2015); Chernev & Chernev (2020) found that about 73% of participants in their studies have good level of education. 4.8% of nondisabled individuals are

unemployed even with good level of education in Sri Lanka and there is no proper mechanism to make disabled individual employed who are with good education. Hence, most of participants of this study have to be self-employed though they have good education level. Nevertheless, we can see that most of them self-directed to rehabilitation without any guidance from the hospitals may be due to this good enough education.

Eighteen percent of the study participants have worked in forces before the amputation and they have satisfactory level of income based on pension scheme. Nevertheless, other participants who engaged in civil occupations before the amputation have significantly low level of income comparatively to those who worked in forces. Though there are policies and legislations in government and private sectors for their employees, only 34% of individuals have ability to continue their job after the amputation which may affect largely on their income and life satisfaction. In addition to that study has found that most of them are been self-employed such as business after the amputation. Government of Sri Lanka has appointed social service officers to each and every divisional secretariat area in order to find out information about the people with disabilities and to improve their empowerment. Nevertheless, very few percentage of these self-employed participants have been taken the help of these officers and most of them are empowered by themselves with the help of their families and friends. Further, the results found that 67% of participants among those who continue their previous job have no ability to work same hours as previous. According to the International Classification of Functioning and Disability (ICF), make individual actively participate in their occupation and improve their empowerment are major concerns in rehabilitation where we have to take more steps forward to improve those aspects in rehabilitation of people with disabilities in Sri Lanka. Further, qualitative analysis of this study found that some of them have went through depression after amputation but now most of them are trying to adapt to the situation and being independent as much as possible. All most all of them are quite satisfied and accepted the life that they received after injury. In addition to that Sri Lanka is a developing country where even non-disabled people struggling with their lives and they naturally courageous as well as adaptive. Hence, majority is in good psychological status where unemployment do not affect their psychological level.

This study found that 2/3 of participants presented with transtibial amputation where we can suggest that transtibial amputation is common than transfemoral amputation in Sri Lanka. Most of our study participants have engaged in rehabilitation early as possible after the amputation which is a good trend in rehabilitation aspect in Sri Lanka. Nevertheless, study cannot straightly say that all the people in Sri Lanka is engaged in rehabilitation and prosthetic fitting after amputation according to the qualitative information gathered from the participants. Qualitative study found that, most of them had not any guidance for rehabilitation and prosthetic fitting at the discharge from the government hospitals. In addition to that, study found that those who have enough facilities, knowledge and bearable economical level only engaged in rehabilitation by themselves after discharge. In contrast to that, those who discharged from forces hospitals had all these rehabilitation guidance and they have taken rehabilitation within those hospitals with significantly higher duration of rehabilitation comparatively to those who taken rehabilitation separately from rehabilitation centres. Hence, the study suggest that government has to be taken actions to improve standard of the government hospitals to deliver proper rehabilitation after discharge and healthcare professional in the government hospitals should be trained and have to be given the treatment time and tasks to give proper guidance to these patients as all the people have equal opportunity to engage in rehabilitation to improve their quality of life.

Previous studies have found that that higher number of males experience lower limb amputation rather than females (Knežević et al., 2016). This study also found the same results and found level or the side of amputation also not affect by the gender. Nevertheless, we cannot apply this findings to whole Sri Lankan population as this study included only who went through amputation due to traumatic and congenital injuries. It is obvious to have more males in this study, as higher number of males are more prone to end up with traumatic injuries such as war and road traffic accidents.

The present study analyzed on condition of the stump such as shape, swelling, scar condition and presence of blisters of the amputation patients and results shows that more than 90% of patients have good conditions of all the parameters. Qualitative study finding also claimed that both government and forces hospitals has provided advices on stump caring. Nevertheless, study found that only 8% of participants performing the accurate stump cleaning procedure with proper stocking and prosthetic

cleaning procedure which can consider low to moderate level of hygienic practices among participants. Even qualitative data explains that most of them not received proper information on good hygienic practices, nutritional intake, weight control and disease prevention and they have only received basic management like wound dressing and caring only. Study can conclude that amputation management and guidance at Sri Lankan hospitals is in a sub-optimal level and government have to take steps for improvements together with the health professionals and rehabilitation teams.

Esfandiari et al. (2017) found that average years since amputation is 22 (3.96) years and prevalence of phantom pain is 63%. This study also found that prevalence of phantom pain is 69% and presence of the phantom pain do not significantly depend on the years since amputation where average years since amputation is 12 (10.25) years. Though studies claimed that phantom symptoms are decline over years (Amtmann et al., 2015; Esfandiari et al., 2017; Houghton, Nicholls, Houghton, Saadah, & McColl, 1994), this study shows that phantom pain exist after longer duration of amputation. Though the prevalence of phantom pain is higher among the participants, quantitative and qualitative data of the study found that phantom pain and its' severity do not significantly impact of their monthly income or psychological status or the usage of prosthesis. Nevertheless, other studies shows contrast findings to his study (Heszlein-lossius et al., 2019; Kahle et al., 2016)

This study shows that 71% of participants are using prosthesis always with 69% of high level of satisfaction. The results further shows that prosthetic usage and satisfaction of prosthetic usage is significantly associated with the level of amputation and show that individuals with below knee amputation have higher level of prosthetic usage and prosthetic usage satisfaction compared to individuals with above knee amputation. Qualitative data found that participants with above knee amputation complains that they feel pain and uncomfortable due to the structure of the prosthesis while walking. Hence, they are more reluctant to walk with the prosthesis. When a normal person walking hip and knee flexion and extension occurs simultaneously. Prosthesis that develops for above knee amputees, do not have that mechanism and most of the participants had circumduction gait with hip hiking while walking. This may be the key factor that they refuse to use the prosthesis always. Therefore, rehabilitation team in Sri Lanka should have to give more concern when developing prosthesis and when give walking training for patients with above knee amputation.

Moreover study found that 34 individuals have average 6 hours of mobility level per day with the prosthesis while 14 individuals have 2 to 3 hours of average mobility level per day without the prosthesis. Participants with below knee amputation have higher satisfaction usage and they have high mobility hours with the prosthesis. In contrast, most of the participants with above knee amputation used to have less mobility even without the prosthesis due to less satisfaction level and mostly they have been mobile only engage in daily activities at home even without the prosthesis. Higher number of individuals have mobility level of 3 hours per day with or without the prosthesis according to the findings. Most of the individual engage in their occupation by sitting with less mobility and most of them are having participation restriction which make them less mobile due to low attitudes of the society as well as less friendly barrier free environment.

The present study found that all of them are well satisfied about the help received from their families and friends and majority not satisfied about the support that they receive from the society. Based on the quantitative and qualitative analysis findings, majority of participants have less number of mobility hours and low social support which enriched the other study findings that social support affects on mobility or walking hours of the individuals. Studies further found that walking ability is not associate with gender. Similarly, this study found that walking hours per day with or without prosthesis is not depend on gender but depend on the level of amputation. Sustainable Development Goals (SDG) in Sri Lanka includes goals for inclusion of the all people in development, make barrier free environment for everyone and to improve everyone's participants in the society. Nevertheless, Sri Lanka still do not have proper accessibilities for people with disabilities in most of the aspects. Therefore, the government of Sri Lanka have to take step forward in order to improve mobility of the patients with amputation and their active participation in the society.

Qualitative analysis of this study also found that number of individual who continue their regular medical rehabilitation is rare. It is not only due to higher cost but also due to almost all the rehabilitation centres are not advice their patient to continue their rehabilitation after patient to able walking with the prosthesis within the rehabilitation centre and they are advised to visit rehabilitation centre only for doing changes of prosthesis which may be after several months or years. In addition to that individuals have problem in economical levels and transportation. These factors

should be addressed when improving rehabilitation of amputation patients in Sri Lanka in future.

5.2. Impact of Socio-demographical and Amputation Status on Physical Functioning and Cardiorespiratory Functions

The study found that according to AMPPRO K level classification around 65% of individuals have ability ambulate with the prosthesis in an environment with high level of barriers. AMPPRO is scale which have to fill up based on performance of the individuals. Hence, this is a validated predictor to analysis the physical functioning of amputees and the study can claimed that findings based on this predictor has higher accuracy. 96% of individuals have ability to perform basic daily activities without assistive devices and it has reduced up to 83% when individuals engaged in advanced activities based on LCI findings. LCI is scale which have to fill up by asking the questions which is not contain any performance. Hence, the study can claimed that findings based on this predictor could be changed when it comes to the real life situations of the participants. Nevertheless, study conclude that the participants have higher level of physical functioning. There are several factors which significantly impact on physical functional level such as level of amputation, years since amputation, time gap between amputation surgery and the date of admission for rehabilitation, prostheis usage and prosthetic usage satisfaction, mobility hours per day.

Below knee amputation patients have higher scores comparatively to above knee amputation patients according to the findings. Demographics data found that above knee amputees have less mobility levels as well as low level of prosthesis usage and satisfctions. All these factors together may impact on low level of physical unctioning anf functional inependancy of above knee amputess. Nevertheless, study found that age, gender, weight and BMI, level of education and pantom pain are not signficantly impact on physical functioning and functions independancy. In contrast, other studies found that age, gender, BMI, level of education and pantom pain are signficantly impact on physical functioning (Amtmann et al., 2015; Esfandiari et al., 2017; Chernev & Chernev, 2020; Kahle et al., 2016; Sions et al., 2018).

Further 6MWT was conducted to find the physical stamina, speed, cadence, gait pattern and distance. The results shows that 6MWD significantly change in

respect to AMPPRO K level, gender, age and level of amputation. Further, the results show that 6MWD of all the participants is lower than its predicted values derived for healthy individuals as well as lower than the reference values derived based on amputation individuals in other countries (Sions, 2019). The study found that some individuals' 6MWD is very much closer to the predicted 6MWD while the difference is higher among some individuals when analyzing the 6MWD of each individuals. Study was not able to find exact factors which make these differences but found combination of one or more factors such as age, income, current job engagement, previous occupation, level of amputation, duration of amputation, duration of rehabilitation, mobility hours per day with the prosthesis, and prosthesis usage satisfaction may cause the impact and other studies also support our study findings (Sions, 2019; Kahle et al., 2016; Knežević et al., 2016; Lin & Bose, 2008). Study found an interesting point that income have moderate positive correlation to the 6MWD. According to the Sri Lankan context this may two aspects such as to earn money they may engaged in more physical activities and they may be engaged in more activities to improve their health status.

Though some scholars, state that survival rate is low those who are with 6MWD less than 300m (Dumke, 2018), all these reference values are generated for able and disable individuals in European countries. Hence, the study recommended that 6MWD values should compare with reference values for Sri Lankans to have exact conclusion about the physical stamina of based on 6MWT and the study encourage future researches to develop Sri Lankan reference values for 6MWT. Further, the results shows that most of the individuals have average level of exertion during and after the 6MWT, this also may be due to less walking speed and cannot directly conclude that they have good level of physical stamina. Further, the study observed that there are some deviations of cadence and walking pattern a when they perform 6MWT but the study did not able to do the biomechanical gait analysis to find the exact deviations and changes of gait as it is really expensive as well as it was not a one of the objectives of the study. Hence, the study recommending future researches to incorporate these concepts when further analyzing the rehabilitation aspects of patients with amputation as these results emphasis the importance of proper gait training after prosthesis fitting.

The study generated VO_2max using the 6MWD of participants which is a validated field method of calculating VO_2max and the results were compared with the

standard reference values of European populations. Then, the results found only 52% have the satisfactory level of cardiovascular endurance based on VO_2max results. Nevertheless, the study encourage future researches to develop reference values for Sri Lankans and to do further research on cardiovascular endurance of patients with amputation to confirm this study findings. Further, the present study measured the respiratory functions of individuals' and found that around 31% have restrictive pattern of respiratory functions which means low lung capacities. Further, the study found that factors such as, gender, current job engagement significantly impact on have good level of respiratory functioning. It is found that, physical functioning and independency measured using AMPPRO and LCI respectively have significant impact on distance walking and cardiorespiratory endurance measured using 6MWT and VO_2max respectively. Kahle et al. (2016) also supported the statement based on their findings. Moreover, the present study found that, there are significance differences between K levels in relation to 6MWD, and VO_2max and individuals with physical functioning of K4 level have higher 6MWD and VO_2max. Sions et al. (2018) similarly found that 6MWD have significant difference based on the K levels where K4 level have higher values. Nevertheless, there is no significant association among level of physical functioning or functional independency and respiratory functioning which measured using spirometry.

Nevertheless, qualitative analysis of this study found that rehabilitation in Sri Lankan context mainly focus on physical functioning, independency and basic walking training of amputation patients but not on long term survival, distance walking and cardiorespiratory endurance. These patients can be end up with comorbidities in their future and mortality rate may be increased in order to this gaps in medical and rehabilitation guidance. Hence, this study recommending to arrange awareness programs to raise the awareness of the society about rehabilitation services and to rehabilitation professionals in Sri Lanka to arrange their rehabilitation programme in much more effective way. Physiotherapist are the professionals who arranging all these rehabilitation and exercise programs during and after prosthesis fitting in Sri Lanka. Nevertheless, Sri Lanka do not have enough institutional based physiotherapists to provide effective rehabilitation programme and they do not have enough facilities and time to focus on a one particular patient for long term rehabilitation. In addition to that, Sri Lanka do not have community based rehabilitation teams at least physiotherapist in order to take care of these patients until

they actively participate in the society. Hence, this study recommend the government of Sri Lanka and responsible authorities to take further steps to fill-up these gaps in future.

Chapter VI
LIMITATIONS

There are several limitations that have found in the study. Most serous limitation was the absence of reference values separately for Sri Lankans for some of the test to be compared. Another most affected limitation was the sample size of the study. Difficulty to access the patients with unilateral lower limb amputation was another limitation that found during the study. Further found that usage of LCI for collecting information in functional independency is not that much valid. Though the study compared the 6MWD of the participants with the reference values, all these reference values are generated for able and disable individuals in European countries. As walking speed at a self-chosen pace appears to be lower in Sri Lankan people compared to western or European persons, those reference values for 6MWT cannot be accurate enough to be compared with Sri Lankan peoples test values. Further, the study generated VO_2max using the 6MWD of participants and again compared with the reference values generated for the European countries. Hence, unavailability of reference values for Sri Lankans may cause significant impact of the study conclusions. Moreover, study was not able to achieve the proposed sample size for the study due to unstable political situation as well as COVID-19 pandemic within Sri Lanka. Adequate sample size is highly impact on the significance of the results and validity of the drawn conclusions. Further, the study had to use nonparametric test for some analysis due to this less number of sample. If the study had an adequate number of sample, the comparison between different groups within the study may also have more strong result. According to the previous studies, Sri Lanka have more than 60000 of amputation patients in population. Hence, around 300 participants were proposed for the study as study was not able to find literatures that shows the prevalence of amputation according to different etiologies. During the study investigators found that it was really difficult task to find participants who match with the study inclusion and exclusion criteria and was not able to achieve exact number of study participants. LCI is scale which have to fill up by asking the questions which is not contain any performance. Hence, the study can claimed that findings based on this predictor could be changed when it comes to the real life situations of the participants which can be consider as a limitation of the study.

Chapter VII
RECOMMENDATIONS

Hence, there are no such reference values for 6MWT and VO_2max, the study recommended future researches to develop Sri Lankan reference values for 6MWT and VO_2max in order to draw more accurate validated conclusions regarding outcomes of patients with amputations in Sri Lanka.

Further, we can analysis not only their walking ability but also deviations of gait via biomechanical gait analysis. Future studies can embed these gait analysis to find more gaps in medical and rehabilitation process and to emphasis the importance of proper gait training after prosthesis fitting in order to give more suggestions to improve patient care and rehabilitation of patients with amputation in Sri Lanka.

This study only consider the patients who engaged in rehabilitation and who visited the rehabilitation centres frequently. Nevertheless, the study recommending the future researches to conduct studies on rehabilitation and outcomes of patients with amputation in Sri Lanka as cooperating the both the individuals who engaged in continuous rehabilitation and prosthetic fitting as well as who are not engaged in rehabilitation and prosthetic fitting in both rural and urban areas. This would be beneficial to identify actual rehabilitation aspect in Sri Lanka as well as the steps that government have to take to make these people actively participate in the society.

As there are very few studies on patients with amputations in Sri Lanka, the study recommending future investigators to conduct more research in this area with large number of samples to have more accurate conclusions.

Chapter VIII
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APPENDIX: A1

Questionnaire of Socio-Demographical and Medical Data

No. :

……

Quantitative questions

1. Name: …….
2. Age: ……..
3. Gender: …….
4. Marital status: Unmarried ☐ Married ☐ Other: …….
5. Ethnicity: Sinhala ☐ Muslim ☐ Tamil ☐ Other ……
6. Home Address:

……..

……

……

7. Telephone No: ……
8. i. Height: ……cm ii. Weight: …….kg iii. BMI: ……
9. Are one or more family members have any of following medical condition;

   Lung Disease ☐ heart diseases ☐ vascular Disease ☐

   DM ☐ Other ……..
10. Years of schooling: …….
11. Monthly income: …….
12. i. Current occupation: …….

ii. That occupation mostly engage in;

Walking ☐ Standing ☐ Sitting ☐ Stair climbing ☐

All about the same time ☐

iii. In that job place you exposed to: Dust ☐ Asbestos ☐

Chemicals ☐ Other ☐ N/A ☐

iv. Are you engaging in the same occupation which you did before the amputation?

Yes ☐ No ☐

v. Are you working for same number of hours which you did before the amputation?

Yes ☐ No ☐

13. History of injury: Road traffic accident ☐
    Industrial Accident ☐
    War ☐
    If other; Specify: ……..

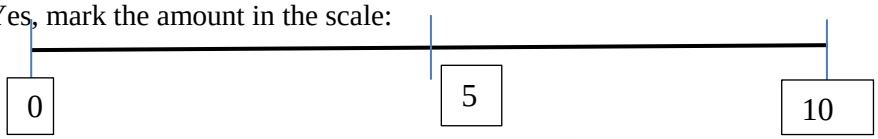
14. Level of Amputation: Through hip ☐
    Above knee ☐
    Through knee ☐
    Below knee ☐
    Through ankle ☐

15. Side of Amputation: Left ☐ Right ☐

16. Duration:
    i. Time since amputation: ……
    ii. Duration of wearing the prosthesis: ……..
    iii. Duration of taking rehabilitation: ……..

17. Stump condition
    Shape: Corn shape ☐ Not proper in shape ☐
    Swollen: Yes ☐ No ☐
    Scar: Healed ☐ Unhealed ☐ Adhesions ☐
    Contractures in joints: Present ☐ Absent ☐
    Blisters due to prosthesis use: Present ☐ Absent ☐ N/A ☐

18. Phantom pain/ symptoms
    i. Pain/symptoms present at current stage: Yes ☐ No ☐
    ii. if Yes, mark the amount in the scale:



    0- No pain or any other symptoms, 10- Unbearable sever pain/symptoms

19. Hygiene:
    Stocking washing: Daily ☐ Twice a week ☐ Once a week ☐
    Other: …….

Stump care: Washing daily with soap and warm water ☐

Washing daily with warm water only ☐

Washing daily with soap and normal water ☐

Washing daily normal water only ☐

Prosthesis cleaning: Daily ☐ Twice a week ☐ Once a week ☐

Other……..

20. Use of prosthesis

Frequency: 24/7 ☐ Usually ☐ Rarely ☐

Satisfaction with prosthesis: High ☐ Moderate ☐ Low ☐

21. Walking minutes per day:

<u>To work place</u>

Without prosthesis: ……..

With prosthesis: ……

<u>Within the working place</u> ,

Without prosthesis: ……

With prosthesis: ……

<u>For shopping, household, and ect,</u>

Without prosthesis: …….

With prosthesis: ……

22. Use of other external appliances, Yes ☐ No ☐ if yes;

i. Type: …….

ii. Occasion: …….

iii. Duration per day: …….

APPENDIX: A2

Locomotor Capabilities Index in Amputees (LCI)

Whether or not you wear your prosthesis, at the present time, would you say that you are "able" to do the following activities WITH YOUR PROSTHESIS ON? Please **circle the number** that best describes your capability.

ITEM	NO	YES, if someone helps me	YES, if someone is near me	YES, alone, with ambulation aids	YES, alone, without ambulation aids
1. Get up from a chair	0	1	2	3	4
2. Walk in the house	0	1	2	3	4
3. Walk outside on even ground	0	1	2	3	4
4. Go up the stairs with a handrail	0	1	2	3	4
5. Go down the stairs with a handrail	0	1	2	3	4
6. Step up a sidewalk curb	0	1	2	3	4
7. Step down a sidewalk curb	0	1	2	3	4
Basic Activities Score					
1. Pick up an object from the floor (when you are standing up with your prosthesis)	0	1	2	3	4
2. Get up from the floor (e.g. if you fall)	0	1	2	3	4
3. Walk outside on uneven ground (e.g. grass, gravel, slope)	0	1	2	3	4
4. Walk outside in inclement weather (e.g. snow, rain, ice)	0	1	2	3	4
5. Go up a few steps (stairs) without a handrail	0	1	2	3	4
6. Go down a few steps (stairs) without a	0	1	2	3	4

handrail					
7. Walk while carrying an object.	0	1	2	3	4
Advanced Activities Score					
Total Score					

APPENDIX: A3
Amputee Mobility Predictor Assessment Tool for Patients Ability or Potential to Use Prosthesis

Initial instructions: Client is seated in a hard chair with arms. The following manoeuvres are tested with or without the use of the prosthesis. Advise the person of each task or group of tasks prior to performance. Please avoid unnecessary chatter throughout the test. Safety First, no task should be performed if either the tester or client is uncertain of a safe outcome.

Patient Name: _____

DOB: _____

Assessor: _____ Date: _____ Time: _____

The **Right Limb** is: ❒ PF ❒ TT ❒ KD ❒ TF ❒ HD ❒ intact

The **Left Limb** is: ❒ PF ❒ TT ❒ KD ❒ TF ❒ HD ❒ intact

1. Sitting Balance: Sit forward in a chair with arms folded across chest for 60s.	Cannot sit upright independently for 60s Can sit upright independently for 60s	= 0 = 1	_____
2. Sitting reach: Reach forwards and grasp the ruler. (Tester holds ruler 12in beyond extended arms midline to the sternum)	Does not attempt Cannot grasp or requires arm support Reaches forward and successfully grasps item.	= 0 = 1 = 2	_____
3. Chair to chair transfer: 2 chairs at 90□. Pt. may choose direction and use their upper limbs.	Cannot do or requires physical assistance Performs independently, but appears unsteady Performs independently, appears to be steady and safe	= 0 = 1 = 2	_____
4. Arises from a chair: Ask pt. to fold arms across chest and stand. If unable, use arms or assistive device.	Unable without help (physical assistance) Able, uses arms/assist device to help Able, without using arms	= 0 = 1 = 2	_____

5. Attempts to arise from a chair: (stopwatch ready) If attempt in no. 4. was without arms then ignore and allow another attempt without penalty.	Unable without help (physical assistance) Able requires >1 attempt Able to rise one attempt	= 0 = 1 = 2	_____
6. Immediate Standing Balance: (**first 5s**) Begin timing immediately.	Unsteady (staggers, moves foot, sways) Steady using walking aid or other support Steady without walker or other support	= 0 = 1 = 2	_____
7. Standing Balance (30s): (stopwatch ready) For item no.'s 7 & 8, first attempt is without assistive device. If support is required allow after first attempt	Unsteady Steady but uses walking aid or other support Standing without support	= 0 = 1 = 2	_____
8. Single limb standing balance: (stopwatch ready) Time the duration of single limb standing on both the sound and prosthetic limb up to 30s. Grade the quality, not the time. **Eliminate item 8 for AMPnoPRO** Sound side _____ seconds Prosthetic side _____ seconds	**Non-prosthetic side** Unsteady Steady but uses walking aid or other support for 30s Single-limb standing without support for 30s **Prosthetic Side** Unsteady Steady but uses walking aid or other support for 30s Single-limb standing without support for 30s	= 0 = 1 = 2 = 0 = 1 = 2	_____ _____
9. Standing reach: Reach forward and grasp the ruler. (Tester holds ruler 12in beyond extended arm(s) midline to the sternum)	Does not attempt Cannot grasp or requires arm support on assistive device Reaches forward and successfully grasps item no support	= 0 = 1 = 2	_____
10. Nudge test: With feet as close together as possible, examiner pushes lightly on pt.'s sternum with palm of hand 3 times (toes should rise)	Begins to fall Staggers, grabs, catches self ore uses assistive device Steady	= 0 = 1 = 2	_____
11. Eyes Closed: (at maximum position #7) If support is required grade as unsteady.	Unsteady or grips assistive device Steady without any use of assistive device	= 0 = 1	_____
12. Pick up objects off the floor: Pick up a pencil off the floor placed midline 12in in	Unable to pick up object and return to standing Performs with some help (table, chair, walking aid etc) Performs independently	= 0 = 1 = 2	_____

front of foot.	(without help)			
13. Sitting down: Ask pt. to fold arms across chest and sit. If unable, use arm or assistive device.	Unsafe (misjudged distance, falls into chair) Uses arms, assistive device or not a smooth motion Safe, smooth motion		= 0 = 1 = 2	_____
14. Initiation of gait: (immediately after told to "go")	Any hesitancy or multiple attempts to start No hesitancy		= 0 = 1	_____
15. Step length and height: Walk a measured distance of 12ft twice (up and back). Four scores are required or two scores (a. & b.) for each leg. "Marked deviation" is defined as extreme substitute movements to avoid clearing the floor.	**a. Swing Foot** Does not advance a minimum of 12in Advances a minimum of 12in **b. Foot Clearance** Foot does not completely clear floor without deviation Foot completely clears floor without marked deviation	= 0 = 1 = 0 = 1	Prosthesis _____ _____	Sound _____ _____
16. Step Continuity	Stopping or discontinuity between steps (stop & go gait) Steps appear continuous		= 0 = 1	_____
17. Turning: 180 degree turn when returning to chair.	Unable to turn, requires intervention to prevent falling Greater than three steps but completes task without intervention No more than three continuous steps with or without assistive aid		= 0 = 1 = 2	_____
18. Variable cadence: Walk a distance of 12ft fast as possible safely 4 times. (Speeds may vary from slow to fast and fast to slow varying cadence)	Unable to vary cadence in a controlled manner Asymmetrical increase in cadence controlled manner Symmetrical increase in speed in a controlled manner		= 0 = 1 = 2	_____
19. Stepping over an obstacle: Place a movable box of 4in in height in the walking path.	Cannot step over the box Catches foot, interrupts stride Steps over without interrupting stride		= 0 = 1 = 2	_____
20. Stairs (must have at least 2 steps): Try to go up and down these stairs without holding on to the railing. Don't hesitate to permit pt. to hold on to rail. Safety First, if examiner feels that any risk in involved omit and score as 0.	**Ascending** Unsteady, cannot do One step at a time, or must hold on to railing or device Step over step, does not hold onto the railing or device **Descending** Unsteady, cannot do One step at a time, or must hold on to railing or device Step over step, does not hold onto the railing or device		= 0 = 1 = 2 = 0 = 1 = 2	_____ _____

21. Assistive device selection: Add points for the use of an assistive device if used for two or more items. If testing without prosthesis use of appropriate assistive device is mandatory.	Bed bound Wheelchair / Parallel Bars Walker Crutches (axillary or forearm) Cane (straight or quad) None	= 0 = 1 = 2 = 3 = 4 = 5	_____
	Total Score AMPnoPRO _____/43 AMPPRO _____/47		

Abbreviation: PF = partial foot; TT = transtibial; KD = knee disarticulation; TF = transfemoral; HD = hip disarticulation

Test: ☐ no prosthesis ☐ with prosthesis **Observer:** _____

K LEVEL (converted from AMP score)

AMPnoPRO ☐ K0 (0-8) ☐ K1 (9-20) ☐ K2 (21-28) ☐ K3 (29-36) ☐ K4 (37-43)

AMPPRO ☐ K1 (15-26) ☐ K2 (27-36) ☐ K3 (37-42) ☐ K4 (43-47)

APPENDIX: A4
Data Collection Sheet for Spirometry and 6MWT

Spirometry

Indicator	Predicted value	Actual Value	%
FVC			
FEV1			
FEV1/FVC%			
PEFR			

6 Min Walk Test

Indicator	Value
Distance	
VO2 max	
Pattern	
HR rest	
HR end	
StO_2 rest	
StO_2 end	
BP rest	
BP end	
Borg scale of perceived exertion	

APPENDIX: A5
Borg Scale

Rating	Descriptor
6	No exertion at all
7	Extremely light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard (heavy)
16	
17	Very hard
18	
19	Extremely hard
20	Maximal exertion

APPENDIX: A6
Standard Normal Values for Cardiorespiratory Functioning

TABLE 4.7

Cardiorespiratory Fitness Classifications ($\dot{V}O_{2max}$) by Age and Sex

$\dot{V}O_{2max}$ (mL $O_2 \cdot kg^{-1} \cdot min^{-1}$)

MEN

		Age Group (yr)				
Percentile		20–29	30–39	40–49	50–59	60–69
95	Superior	66.3	59.8	55.6	50.7	43.0
90		61.8	56.5	52.1	45.6	40.3
85	Excellent	59.3	54.2	49.3	43.2	38.2
80		57.1	51.6	46.7	41.2	36.1
75		55.2	49.2	45.0	39.7	34.5
70	Good	53.7	48.0	43.9	38.2	32.9
65		52.1	46.6	42.1	36.3	31.6
60		50.2	45.2	40.3	35.1	30.5
55		49.0	43.8	38.9	33.8	29.1
50	Fair	48.0	42.4	37.8	32.6	28.2
45		46.5	41.3	36.7	31.6	27.2
40		44.9	39.6	35.7	30.7	26.6
35		43.5	38.5	34.6	29.5	25.7
30	Poor	41.9	37.4	33.3	28.4	24.6
25		40.1	35.9	31.9	27.1	23.7
20		38.1	34.1	30.5	26.1	22.4
15		35.4	32.7	29.0	24.4	21.2
10	Very poor	32.1	30.2	26.8	22.8	19.8
5		29.0	27.2	24.2	20.9	17.4
		(n = 513)	(n = 963)	(n = 1,327)	(n = 1,078)	(n = 593)

WOMEN						
		Age Group (yr)				
95	Superior	56.0	45.8	41.7	35.9	29.4
90		51.3	41.4	38.4	32.0	27.0
85	Excellent	48.3	39.3	36.0	30.2	25.6
80		46.5	37.5	34.0	28.6	24.6
75		44.7	36.1	32.4	27.6	23.8
70	Good	43.2	34.6	31.1	26.8	23.1
65		41.6	33.5	30.0	26.0	22.0
60		40.6	32.2	28.7	25.2	21.2
55		38.9	31.2	27.7	24.4	20.5
50	Fair	37.6	30.2	26.7	23.4	20.0
45		35.9	29.3	25.9	22.7	19.6
40		34.6	28.2	24.9	21.8	18.9
		Age Group (yr)				
Percentile		20–29	30–39	40–49	50–59	60–69
35		33.6	27.4	24.1	21.2	18.4
30	Poor	32.0	26.4	23.3	20.6	17.9
25		30.5	25.3	22.1	19.9	17.2
20		28.6	24.1	21.3	19.1	16.5
15		26.2	22.5	20.0	18.3	15.6
10	Very poor	23.9	20.9	18.8	17.3	14.6
5		21.7	19.0	17.0	16.0	13.4
		(n = 410)	(n = 608)	(n = 843)	(n = 805)	(n = 408)

Percentiles from cardiopulmonary exercise testing on a treadmill with measured $\dot{V}O_{2max}$ (mL $O_2 \cdot kg^{-1} \cdot min^{-1}$). Data obtained from the Fitness Registry and the Importance of Exercise National Database (FRIEND) Registry for men and women who were considered free from known CVD.

APPENDIX: A7
Unstructured Open Ended Questionnaire of Qualitative Study

1. How do you perceive the rehab (instructions, exercises, prosthesis making, advices for hygiene, nutrition) what do you like most – what don't you like at all- what aspects have you missed?
2. Support from peers in centre / interactions
3. Barriers to have the rehabilitation in proper way

APPENDIX: A8
Approval from The Research and Evaluation Unit, CRP, Savar

বাংলাদেশ হেল্‌থ প্রফেশন্স ইনস্টিটিউট (বিএইচপিআই)
Bangladesh Health Professions Institute (BHPI)
(The Academic Institute of CRP)

Ref. CRP-BHPI/IRB/11/2020/406

Date: 11th November 2020

To
D.A.R.K. Dasanayaka
5th Batch (Part-II) M.Sc. in Rehabilitation Science (MRS)
Session: 2018-19, Student ID: 181170121
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

Subject: Approval of the thesis proposal "**Physical and Cardiorespiratory Functioning of Patients with Unilateral Lower Limb Amputation in Sri Lanka**" by ethics committee.

Dear D.A.R.K. Dasanayaka,

Congratulations.

The Institutional Review Board (IRB) of BHPI has reviewed and discussed your application to conduct the above mentioned dissertation, with yourself, as the Principal investigator. The Following documents have been reviewed and approved:

Sr. No.	Name of the Documents
1	Dissertation Proposal
2	Questionnaire (English version)
3	Information sheet & consent form.

The purpose of the study is to assess the outcomes of patients with unilateral lower limb amputation in Sri Lanka who engaged in rehabilitation. The study involves taking personal details and health related details by having face to face interview, measuring activity level using standard questionnaires (AMPPRO and LCI), measuring cardiorespiratory endurance using 6MWT and measuring lung function using a Spirometer which may take 45-60minutes. There is no likelihood of any harm to the participants. The members of the Ethics committee have approved the study to be conducted in the presented form at the meeting held at 09.00 AM on 18th February 2019 at BHPI (20th IRB Meeting).

The institutional Ethics committee expects to be informed about the progress of the study, any changes occurring in the course of the study, any revision in the protocol and patient information or informed consent and ask to be provided a copy of the final report. This Ethics committee is working accordance to Nuremberg Code 1947, World Medical Association Declaration of Helsinki, 1964 - 2013 and other applicable regulation.

Best regards,

Millat Hossain

Muhammad Millat Hossain
Assistant Professor, Dept. of Rehabilitation Science
Member Secretary, Institutional Review Board (IRB)
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

সিআরপি-চাপাইন, সাভার, ঢাকা-১৩৪৩, বাংলাদেশ, ফোন ঃ ৭৭৪৫৪৬৪-৫, ৭৭৪১৪০৪ ফ্যাক্স ঃ ৭৭৪৫০৬৯
CRP-Chapain, Savar, Dhaka-1343, Tel : 7745464-5, 7741404, Fax : 7745069, E-mail : contact@crp-bangladesh.org, www.crp-bangladesh.org

APPENDIX: A9
Request Letter for the Research and Evaluation Unit, CRP, Savar

Date: 03-Nov 2020

To
The Chairman
Institutional Review Board (IRB)
Bangladesh Health Professions Institute (BHPI)
CRP-Savar, Dhaka-1343, Bangladesh

Subject: Application for review and ethical approval

Respected Sir,

With due respect, I am D.A.R.K. Dasanayaka, student of M.Sc. inRehabilitation Science program at Bangladesh Health Professions Institute (BHPI)- anacademic institute of CRP under Faculty of Medicine, University of Dhaka (DU). I have to conduct athesis entitled, "Physical and Cardiorespiratory Functioning of Patients with Unilateral Lower Limb Amputation in Sri Lanka", under the honorable supervisor, **Md.Fazlul Karim Patwary, Professor, Institute of Information technology, Jahangirnagar University, Bangladesh**.The purpose of the study is to assess the outcomes of patients with unilateral lower limb amputation in Sri Lanka who engaged in rehabilitation.

The study involves taking personal details and health related details by having face to face interview, measuring activity level using standard questionnaires (AMPPRO and LCI), measuring cardiorespiratory endurance using 6MWT and measuring lung function using a Spirometer which may take 45-60minutes. There is no likelihood of any harm to the participants and /or participation in the study may benefit the participants or other stakeholders. Written informed consent will be taken from all participants and collected data will be kept confidential.

Therefore, I look forward to having your kind approval for the thesis proposal and to startdata collection. I can also assure you that I will maintain all the requirements for study.

Sincerely,

D.A.R.K. Dasanayaka
Part-II MRS 5th Batch
Studentof M.Sc. in Rehabilitation Science (MRS)
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

Recommendation from the thesis supervisor:
Md. Fazlul Karim Patwary
Professor, Institute of Information technology, Jahangirnagar University, Bangladesh

APPENDIX: A10
Approval from Center for Handicapped, Kandy, Sri Lanka

D.A.R.K. Dasanayaka
Department of Rehabilitation sciences
Bangladesh Health professional Institute
Faculty of Medicine, University of Dhaka
Bangladesh
10.07.2019

General Manager
Center for Handicapped
Kandy.

Dear Sir,

Requesting permission for data collection for the research

I am D.A.R.K. Dasanayaka, a master student of Department of Rehabilitation Science, BHPI, Bangladesh requesting permission to do data collection from the amputation patients of Center for Handicapped, Kandy for my MSc. Research. My research is to evaluate the "Physical and Respiratory Functioning of Patients with Unilateral Lower Limb Amputation in Sri Lanka" which is really very important in rehabilitation of amputation patients. This research supposed to be conducted from August 2019 to December 2019. In addition to that I will submit a copy of my research theses to the center for future usage.

It is really very helpful if you can grant me the permission to conduct this research in your center.

Thank You
Yours Faithfully,

.....
(D.A.R.K. Dasanayaka)

Recommended
10/07/2019
Muhammad Millat Hossain
Assistant Professor
Project & Course Coordinator
Dept. of Rehabilitation Science
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

Recommended
10.7.19
MD. FAZLUL K PATWARY
PROFESSOR
I I T
JAHANGIRNAGAR UNIVERSITY

APPENDIX: A11

Consent Form – English version

I am **Ms. D.A.R.K. Dasanayaka** student in M.Sc. in Rehabilitation Science, Department of Rehabilitation Science, BHPI, CPR- Chapain, Savar, Dhaka. I am doing a research on **Physical and cardiorespiratory functioning of patients with unilateral lower limb amputation in Sri Lanka**. This research proposal has been reviewed and approved by the Research and evaluation unit, CRP. This study will help to understand how lung functions change according to the level of activity of unilateral lower limb amputee patients. This form provides you information and invites you to be part of this research. You may discuss the research with anyone you are comfortable with before making a decision to participate or not. This form may contain certain words that you not clearly understand. Please do not hesitate to stop me at any point if you have any questions or need clarification.

I would like to ask you about your personal details and health related details by having face to face interview. I will also ask you about your activity level using standard questionnaires, and I will measure your lung function using a Spirometer. It may not cause any physical or mental risk or harm during or after participating this study.Your participation in this research is entirely voluntary. If you choose not to participate in this research project, please do not hesitate to let me know of your decision. You can change your mind at any time during this research and stop participating even if you agreed to participate now.

There are no direct benefits for you by participating in this research, but your participation is likely to help me find the answer to the research question. There will be no benefit to the society at this stage of the research, and I think that future generations will benefit because the results may provide basis for the modification in the rehabilitation process in order to improve lung function. I am unable to reimburse you for your participation in this research either monetarily or any other form of gift(s) but I will be grateful for your participation. The information that I collect from this research project will be kept confidential. It will not be shared with or given to anyone.

If you have any questions, you may ask me now or later, even after the study has started. If you wish to ask questions later, you may contact me through following contact details.

Name with title: D.A.R.K. Dasanayaka

Address: Department of Physiotherapy, Faculty of Allied Health Sciences, University of Peradeniya

Consent:

I have read the previous information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily to participate as a participant in this research.

Name of Participant: …….

Signature of Participant: ……

Date: ……

If illiterate:

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Name of witness: ……

Thumb print of participant

Signature of witness: ……

Date: ……..

I have explained the study to the above volunteer and he/ she has indicated her willingness to take part.

Signature of investigator: ……...……..

Date…….

Name: ……

APPENDIX: A12

Consent Form- Singhala Version

කැමැත්ත ප්‍රකාශිත පත්‍රය

ඩී. ඒ. ආර්. කේ. දසනායක වන මම දැනට පුනරුත්ථාපනය සම්බන්ධ පශ්චාත් උපාධියක් හදාරන අතර එහි අංගයක් ලෙස "පාදයක කොටස් ඉවත් කරන ලද ශ්‍රී ලාංකිකයින්ගේ කායික හා ස්වසන ක්‍රියාකාරිත්වය මැනීම" යන සමීක්ෂණය සිදු කිරීමට තීරණය කර ඇත. මෙම සමීක්ෂණය මාගේ අධ්‍යාපන ආයතනය මගින් අනුමත කර ඇත. මෙමගින් අයෙකුගේ කායික ක්‍රියාකාරිත්වය , ස්වසන ක්‍රියාකාරිත්වයට බලපාන අයුරුත් පුනරුත්ථාපන වැඩසටහන මගින් ඔවුන්ගේ කායික හා ස්වසන ක්‍රියාකාරිත්වය වැඩිදියුණු වී ඇති අයුරුත් සමීක්ෂණයට භාජනය වේ.

මෙම පත්‍රිකාව මගින් සමීක්ෂණය පිළිබඳ කෙටි හැඳින්වීමක් ලබා දෙන අතර ඔබට ඒ සඳහා සහභාගි වෙන මෙන් ඉල්ලා සිටිමු. ඔබ කැමති දන්නා අයෙකු සමඟ සාකච්ඡා කර හෝ මෙයට සහභාගි වීමට හෝ නොවීමට අදහස් දැක්විය හැක. මෙහි සඳහන් සියලු දෑ ඔබට තේරුම් ගැනීමට හැකි ලෙස සරලව සඳහන් කර ඇති අතර මා එය කියවන අතරතුර අපැහැදිලි තැනක් ඇත්නම් ඕනෑම විටක ප්‍රශ්න කළ හැක.

මේ සඳහා පෞද්ගලික විස්තර හා වෛද්‍ය වාර්තා පිළිබඳ විස්තර මුහුණට මුහුණ කථා කිරීමෙන් ලබාගන්නා අතර කායික හා ස්වසන ක්‍රියාකාරිත්වය මැන බැලීම සඳහා විවිධ පරීක්ෂණ සිදු කරනු ලබයි. මෙම කිසිදු පරීක්ෂණයක් ඔබට කිසිදු කායික හෝ මානසික පීඩාවක් ඇති නොකරනු ඇත. මෙම සමීක්ෂණය සඳහා සහභාගිවීම සම්පූර්ණයෙන්ම ස්වේච්ඡා සහගත වන අතර ඔබගේ අකමැත්තක් වේ නම් එය ප්‍රකාශ කිරීමට කිසිදු බාධාවක් නැත. සමීක්ෂණයේ අතර තුරදී උවද අකමැතිනම් එය ප්‍රකාශකර ඉවත් විය හැක.

මෙයට සහභාගි වීමෙන් කිසිදු සෘජු ප්‍රතිලාභයක් නැති අතර නමුදු එයින් ඉදිරියට සමාජයට වැඩදායි ප්‍රතිඵලයක් ලබා ගත හැක. ඒ අනුව ඉදිරි පුනරුත්ථාපන කටයුතු සඳහා සහභාගි වන පාදූ අහිමි අයට ඉතා විශිෂ්ඨ ප්‍රතිඵල ලබා කර ගත හැක. මෙයට සහභාගි වන ඔබට කිසිදු මුදල් හෝ වෙනත් තෑගෑයන් ලබා නොදෙන අතර ඔබගේ සහභාගි වීම ඉතා අනගි ලෙස සලකන්නෙමු. මෙහි දී ලබා ගන්නා ඔබගේ තොරතුරු ඉතා රහසිගතව පුරැකීමටත් වෙන කිසිදු අයෙකුට ලබා නොදීමටත් කටයුතු කරමු.

ඔබට සමීක්ෂණය අවසන් වීමෙන් පසු කිසිදු ගැටලුවක් ඇති වුවහොත් පහත සඳහන් නම සහ ලිපිනයට හෝ දුරකථන අංකයට සම්බන්ධ විය හැක.

නම : ඩී. ඒ. ආර්. කේ. දසනායක
ලිපිනය : භෞතචිකිත්සක දෙපාර්තමේන්තුව, සම සෞඛ්‍ය විද්‍යා පීඨය, ජේරාදෙණිය විශ්වවිද්‍යාලය
දුරකථන අංකය : 071 5 494 319

කැමැත්ත ප්‍රකාශය

මා විසින් ඉහත සඳහන් සියලු විස්තර කිය වූ හෝ ඇසූ අතර මා හට මිනැම විටක නැගෑන ප්‍රශ්නයක් ඇසීමට හැකියාව ඇති බව වටහා ගනිමි. මා මෙම සමීක්ෂණය සඳහා ස්වේච්ඡාවෙන් සහභාගි වීමට කැමැත්ත පළ කරමි.

සහභාගිවන්නාගේ නම : .....

සහභාගිවන්නාගේ අත්සන : ..... දිනය :.....

සහභාගිවන්නා වෙනුවෙන්;

සහභාගි වන්නා සමීක්ෂණය පිළිබඳ සියලු තොරතුරු දන්නා බවටත් ඔහුට / ඇයට මිනැම විටක ප්‍රශ්න නිරාකරනය කර හැකි අතරත් මහු / ඇය ස්වේච්ඡාවෙන් සහභාගි වන බවටත් සාක්ෂි දරමි.

සාක්ෂිකරුගේ නම : .....

සාක්ෂිකරුගේ අත්සන : ..... දිනය :.....

ඉහත සහභාගිකරුට සමීක්ෂණය පිළිබඳ සියලු තොරතුරු ලබා දුන් අතර ඔහු / ඇය මෙයට ස්වේච්ඡාවෙන් සහභාගි වීමට කැමැත්ත පළ කළ බව සහතික කරමි.

සමීක්ෂණකරුගේ නම : .....

සමීක්ෂණකරුගේ අත්සන : ..... දිනය :.....

APPENDIX A13

CV of the Investigator

D.A.R.K. DASANAYAKA

Department of Physiotherapy, Faculty of Allied Health Sciences, University of Peradeniya,
Sri Lanka
T.P: +9471-5494319
Email: renukadasanayaka@gmail.com

EDUCATIONAL QUALIFICATIONS

Following MSc in Rehabilitation Science **(2018- to date)**
Bangladesh Health Professions Institute (BHPI),
University of Dhaka, Dhaka, Bangladesh

MSc. in Applied Statistics (with 3.48 average GPA) **(2018)**
Post Graduate Institute of Science, University of Peradeniya
Sri Lanka

Followed certificate course in Psychology and Basic Counseling Skills **(2017)**
Faculty of Arts, University of Peradeniya

BSc in Physiotherapy (Hons) (with 3.24 average GPA) **(2014)**
Department of Physiotherapy
Faculty of Allied Health Sciences
University of Peradeniya, Sri Lanka

Diploma in Exercise and Sport Sciences (with 3.19 GPA) **(2013)**
Faculty of Medicine, University of Peradeniya
Sri Lanka

PROFESSIONAL QUALIFICATIONS

Lecturer (probationary) **(July 2019- to date)**
Department of Physiotherapy
Faculty of Allied Health Sciences, University of Peradeniya
Sri Lanka

Visiting Lecturer **(May 2018- to date)**
Diploma in Exercise and Sports Sciences
Faculty of Medicine,
University of Peradeniya, Sri Lanka

Visiting Lecturer **(May 2017 –July 2018)**
Department of Sport Sciences and Physical Education
Faculty of Applied Sciences
Sabaragamuwa University of Sri Lanka

Temporary Lecturer **(November 2015- July 2018)**
Department of Physiotherapy
Faculty of Allied Health Sciences, University of Peradeniya
Sri Lanka

Temporary Demonstrator **(April 2015- October 2015)**
Department of Physiotherapy
Faculty of Allied Health Sciences, University of Peradeniya
Sri Lanka

Physiotherapist **(2015- to date)**
Service Unit, Department of Physiotherapy
Faculty of Allied Health Sciences, University of Peradeniya
Sri Lanka

Community Base Rehabilitation Physiotherapist **(June 2016 – July 2018)**
Department of Physiotherapy, Faculty of Allied Health sciences
University of Peradeniya

Locum Physiotherapist **(September 2014-March 2015)**
Hemas Hospitals pvt. Ltd. , Wattala
Sri Lanka

Volunteer Physiotherapist **(2012 – July 2018)**
Physio Life Care Institute, Ampagala
Sri Lanka

Executive Officer on Research and Social Development **(2013- July 2018)**
Physio Life Care Institute, Ampagala
Sri Lanka

Volunteer Physiotherapist **(2016 – July 2018)**
Charted Society of Physiotherapist
Sri Lanka

Presented Conferences;

Oral presentation on Management of a case with Grade II chronic lateral ankle sprain using three track clinical reasoning **(2019)**
SAMR'19, Sri Lanka

Oral presentation on Effectiveness of the modified facial electrotherapy treatment on facial rejuvenation and psychological wellbeing of adult women in Sri Lanka **(2017)**
WDRC 2017, Sri Lanka

Postal presentation on Impact of aging on lung functions of Sri Lankan adults
SPCRS 2017, Singapore **(2017)**

Oral presentation on Effects of Aerobic Training (AT) and Resistance Training (RT) on Body Composition **(2015)**
iPURSE,
University of Peradeniya, Sri Lanka

Postal presentation on Aerobic Capacity among Disabled Athletes (DA) And Disabled Non-Athletes (DNA) and Able Body Athletes (ABA) In Sri Lanka **(2015)**
World Congress in Sports and Exercise Medicine
Malaysia

Followed Short Courses;

Appropriate Paper-Based Technology (APT) **(2018)**
Center for the Rehabilitation and Paralysed (CRP)
BHPI, Savar, Dhaka, Bangladesh

Followed certificate course in Orthopedic Manual Therapy **(2017)**
Virtued Academy Internationals, India

Human Resource Management **(2014)**
Center for Environmental Studies
University of Peradeniya, Sri Lanka

Certificate in Basic Rescue **(2014)**
Faculty of Medicine, University of Perdeniya, Sri Lanka

Participated Workshops;

Case report writing **(2019)**
Faculty of Medicine
University of Colombo, Sri Lanka

Evidence Based Practice Physiotherapy **(2018)**
Faculty of Allied Health Sciences
University of Peradeniya, Sri Lanka

Stroke Rehabilitation **(2018)**
Peradeniya University Physiotherapy Congress (PUPCon)
Faculty of Allied Health Sciences
University of Peradeniya

Geriatric Physiotherapy **(2018)**
Faculty of Allied Health Sciences
University of Peradeniya

Time Series Analysis in Data Science **(2017)**
Board of Statistics and Computer Science
Post Graduate Institute of Science, University of Peradeniya, Sri Lanka

Exercise Prescription **(2017)**
SPCRS 2017, Singapore

Healthy Cocking **(2017)**
SPCRS 2017, Singapore

Basic Lung Auscultation, ECG for Exercise Science and Physiotherapy, Liaison Psychiatry for Physical Rehabilitation, Responsibility of Sports Physiotherapist in PPE **(2017)**
Sri Lanka Society of Physiotherapy, Sri Lanka

Holistic Care-Physiotherapy for critically ill **(2017)**
Collage of Anaesthesiologists and Intensivists of Sri Lanka
Faculty of Critical Care Medicine, Sri Lanka

Women's Health Physiotherapy **(2017)**
Faculty of Allied Health Sciences
University of Peradeniya, Sri Lanka

Ergonomics for Physiotherapist **(2016)**
Faculty of Allied Health Sciences
University of Peradeniya, Sri Lanka

Scientific Writing **(2016)**
Post Graduate Institute of Science, University of Peradeniya
Sri Lanka

Muscle Energy Techniques and Visceral Osteopathy **(2016)**
Faculty of Allied health Sciences
University of Peradeniya, Sri Lanka

Introductory Course on Neuro-Development Therapy (NDT) **(2015)**
Faculty of Allied Health Sciences
University of Peradeniya, Sri Lnaka

Post Congress Session on "Management of Children with Cerebral Palsy" **(2014)**
Peradeniya Teaching hospital, Peradeniya, Sri Lanka

Multidisciplinary Approach to Children with Disabilities **(2014)**
The Lady Ridgeway Hospital for Children
Colombo, Sri Lanka

Participated Conferences;

2nd South Asian Conference on Multidisciplinary research (2019)
Colombo, Sri Lanka

Peradeniya University Physiotherapy Congress (PUPCon) (2018)
Faculty of Allied Health Sciences, University of Peradeniya, Sri Lanka

2nd World Disability and Rehabilitation Conference (WDRC) (2017)
Colombo, Sri Lanka

Singapore Prevention & Cardiac Rehabilitation Symposium (SPCRS) (2017)
Novotel Clarke Quay, Singapore

Peradeniya University Physiotherapy Congress (PUPCon) (2016)
Faculty of Allied Health Sciences, University of Peradeniya, Sri Lanka

Peradeniya University International Research Sessions (iPURSE) (2015)
University of Peradeniya, Sri Lanka

World Congress in Sports and Exercise Medicine (2015)
Malaysia

One Health International Conference (2014)
Faculty of Medicine, University of Peradeniya, Sri Lanka

Organizing Committees;

Peradeniya University Research Session (iPURS) (2017)
Faculty of Allied Health Sciences, University of Peradeniya

Peradeniya University Physiotherapy Congress (PUPCon) (2016 , 2017, 2018)
Department of physiotherapy, Faculty of Allied Health Sciences, University of Peradeniya

Workshop on Application of Therapeutic Taping (2016)
Alumni Association, Department of Physiotherapy, Faculty of Allied Health Sciences
University of Peradeniya

Annual Workshop on "Sports Injury Prevention" **(2015 to 2017)**
Department of physiotherapy, Faculty of Allied health sciences, University of Peradeniya

Symposium on "Together for a better world for all including persons with disabilities" **(2012)**
Department of Physiotherapy, Faculty of allied Health Sciences,
University of Peradeniya

MEMBERSHIPS, OFFICES AND RESOURCE PERSON

Memberships

- Sri Lanka Medical Council ***(Reg No. 673)***
- Peradeniya University Explores Club
- Charted Society of Physiotherapy
- Alumni Association, Department of Physiotherapy

Offices

- Academic sub warden (Part time), Hilda Obesekara Hall, University of Peradeniya **(2016- July 2018)**
- Assistant treasurer of the Alumni Association of Department of Physiotherapy, Faculty of Allied Health Sciences, University of Peardeniya **(2015- 2018)**

Resource person

- Workshop on "Awareness program on Physiotherapy in CBR" **(2017)**
  Social Service Offices
  Kandy District, Sri Lanka

- Workshop on "Sports Injury Prevention" **(2017)**
  Athletic Team
  University of Peradeniya, Sri Lanka

- Workshop for sports officers of Kandy district **(2015- 2016)**
  Department of Sports development, Sri Lanka

- Workshop on “Sports Injury Prevention” **(2015- 2017)**
  “Army Sports Masseur and Assistant Physiotherapist course”
  Office of Director General Sports

RESEARCH PUBLICATIONS

Journals

Perera, W.K.L., Jayawardana, R.A.D.T.M., Pathirage, S. L., Dias D.K., & Dasanayaka, D.A.R.K. (2020). Occlusal and Functional Improvement of Patients With Midfacial Hypoplasia Corrected Using Intraoral Tooth-Borne Mid-Maxillary Osteodistractors at Teaching Hospital-Karapitiya, Sri Lanka. The Cleft palate-craniofacial journal: official publication of the American Cleft Palate-Craniofacial Association, 1055665620980220. Advance online publication. https://doi.org/10.1177/1055665620980220

Dasanayaka DARK, Herath HMKB, Shamima Islam Nipa (2019), Management of a case with grade II chronic lateral ankle sprain using three track clinical reasoning, SAMR’19, Vol 2, pp. 36-39.

Herath HMKB, Dasanayaka DARK. (2019), The effect of BMI based nutritional status on lung functions of healthy adults in Sri Lanka, SAMR’19, Vol 2, pp. 56-59.

Dasanayaka DARK, Prof. Wijekoon P. (2018), Reference Values for Spirometry for Healthy Sri Lankan Adults: Age between 20 To 65 Years, Sch. J. App. Med. Sci., Vol 6 (9), pp. 3421-3431.

Dasanayaka DARK, Malwanage VMBKT, Senerath MKID, Liyanage E. (2017), Assessing the knowledge and practice of ergonomics among the students of Faculty of Allied Health Sciences, University of Peradeniya, International Journal of Recent Scientific Research (IJRSR), Vol. 8 (12), pp. 22838-22841.

Abstracts

Dasanayaka DARK, Weerasinghe WMS, Herath HMKB, Thunpattu TMUS, Weerasinghe WMSA. Effectiveness of the modified facial electrotherapy treatment on facial rejuvenation and psychological wellbeing of adult women in Sri Lanka. **WDRC 2017, pp.13**

Dasanayaka DARK, Herath HMKB. Impact of aging on lung functions of Sri Lankan adults. **SPCRS 2017, pp.54**

Herath HMKB, Dasanayaka DARK. Effectiveness of intensive care postoperative physiotherapy intervension and early mobilization on cardiac rehabilitation ; case study of a patient with coronary artery bypass surgery. **SPCRS 2017, pp.13**

Dasanayaka DARK, Wickemanayake KM, Lakmali AP, Madhushanka AMR, Perera JAGF, Ranaweera KKTP, Banneheka BMHSK. Effects of Aerobic Training(AT) and Resistence Training (RT) on body composition on first year female students in university of peradeniya. **iPURSE 2015, vol.19;136, pg. 184**

Dasanayaka DARK, Rajaratna AAJ, Mayooran S, Jayawardana RADWU, A comparative study of aerobic capacity among Disabled Athletes (DA) and Disabled Non-Athletes (DNA) and Able Body Athletes (ABA) in Sri Lanka, **WCSEM 2015, pg.85**

RESEARCH TO BE PUBLISHED

H.M.K.B. Herath, T.M.U.S. Tunpattu, D.H.P. Chathurangi, D.A.R.K. Dasanayaka, Adverse Reactions and it's prevalence after Covishield Vaccination among Healthcare Workers in Sri Lanka

H.M.K.B. Herath, T.M.U.S. Tunpattu, W.M.S. Weerasinghe, D.H.P. Chathurangi, D.A.R.K. Dasanayaka, Knowledge, attitude and practice of Tele-Health among Physiotherapists in Sri Lanka

M.K.I.D. Senarath, A.L.I. Prasanna, S. Mayooran, V.V. Senadheera, V.M.B.K.T. Malwanage, D.A.R.K. Dassanayaka, the effectiveness of low-level laser therapy for nonspecific chronic low back pain

OTHER QUELIFICATIONS

IELTS **(2018)**

Certification of University Test for English Language (UTEL) **(2014)**
Ministry of Higher Education, Sri Lanka

Workshop on Leadership and Team Development **(2009)**
University of Peradeniya, Sri lanaka

National certification in computer application (Basic Level)
Computer Resource Center, Godakawela

SPORTS ACTIVITIES

Member of the 1st runner up Cricket Team **(2010)**
AHS Games, Faculty of Allied Health Sciences, University of Peradeniya

Member of the champion Elle Team **(2010)**
AHS Games, Faculty of Allied Health Sciences, University of Peradeniya

Member of the champion Chess Team **(2010)**
AHS Games, Faculty of Allied Health Sciences, University of Peradeniya

Member of the 1st runner up Netball Team **(2010)**
AHS Games, Faculty of Allied Health Sciences, University of Peradeniya

PERSONAL PROFILE

Name in Full : Dasanayaka Arachchillage Renuka Kusum Dasanayaka

Date of Birth : 15/12/1987

NIC Number : 878502744v

School Attended : Sumana Balika National School, Ratnapura

Gender : Female

Civil Status : Single

Nationality : Sri Lankan

Interests **:** Hiking and Adventuring**,** Learn new Physiotherapy techniques, Learn on multidisciplinary team approach, Playing Badminton and Cricket

Research Interests **:** Rehabilitation (Neurological, Cardio respiratory, Musculoskeletal and Pediatric)

Career Objective **:** Following a challenging career in the department of Physiotherapy and the Faculty of Allied Health Sciences where I can contribute to the growth of the department and the faculty and the profession with my skills & competencies

I hereby certify that the above information is true and accurate to the best of my knowledge.

Dasanayaka D.A.R.K 20/02/2021