



IDENTIFICATION OF ERGONOMIC DEMANDS RELATED TO THE USE/ABANDONMENT OF LOWER PROSTHESIS BY THE ELDERLY

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ABSTRACT

Despite the growing need to use prostheses for lower limbs (LLPs) in recent years due to the high number of elderly amputees in the same period, the abandonment of assistive technology devices has increased in similar proportions in the national territory, as pointed out in specialized literature. This article aimed to demonstrate how that demand contributed to identify the demand exposed in literature at the Centro Especializado em Reabilitação (CER IV). For this, the demands collected in the theoretical documental study were confronted with those obtained in research located with health professionals who participate in the rehabilitation treatment of the elderly with lower limb amputee at CER IV situated in the city of Campina Grande/PB. The abandonment tendency of the lower limb prostheses by the elderly in rehabilitation was noticed, establishing the research problem and directing the investigation focus of an evaluative study that aims to verify if the elderly would abandon specific models in terms of apparent usability.

KEYWORDS: Lower limb prosthesis; Elderly amputee; Ergonomic Analysis; COVID -19.

1. INTRODUCTION

Over the past eight years, the number of elderly individuals has risen by 20%, demonstrating the trend of population aging in the Brazilian population (AGÊNCIA BRASIL, 2020). Along with this, there has been an increase in cases of lower limb amputations among the elderly, and consequently, a growth in the need for the use of assistive technology devices (ATDs). These products aim to contribute to the restoration of an individual's autonomy in performing activities of daily living, with the goal of enabling people with reduced mobility to return to

an active social life (BIFFI et al., 2017; BOIANI, MEDOLA, and PASCHOARELLI, 2016; COSTA et al., 2015; DIOGO, 2003).

Despite the growing need for the use of assistive devices, as evidenced by the increasing elderly population and the number of lower limb amputations, there has been a rise in abandonment rates of their use. According to data from WHO (2016), approximately 75% of ATDs are abandoned by users. According to Sugawara et al. (2018), prostheses for lower limbs are among the ATDs with one of the highest abandonment rates.

The causes are associated with various factors. According to Federici et al. (2016), they emphasize the failure to meet the real needs and expectations of the user. Pichler and Merino (2017) state that assistive technology devices that meet the user's needs and expectations enable a positive user experience and interaction, reducing the likelihood of abandonment and increasing satisfaction and prolonged use.

The practical, aesthetic, and symbolic aspects mentioned by Lobach (2001) influence the acceptance of assistive technology devices by the user, with one aspect having a greater impact than another, depending on the type and characteristics of the product/device in question (LANUTTI et al., 2015; SILVA and SADER, 2019). When it comes to orthotics and prosthetics, Bortolan et al. (2020) and Sansoni et al. (2015) point out that, despite the practical function being of great importance, when considering physically disabled and elderly users, the symbolic and aesthetic aspects also significantly influence the acceptance of these devices by the individual.

Considering this logic, low acceptance can lead to the abandonment of the product, which occurs when it does not adequately meet the user's needs and expectations regarding practical attributes related to use, aesthetic attributes related to appearance, and symbolic attributes associated with the social and cultural function of the product (BORTOLAN et al., 2020; PICHLER and MERINO, 2017; TORRENS, 2012).

From the perspective of Ergonomic Design, Biffi et al. (2017), Bortolan et al. (2020), Pichler and Merino (2017), Porsani et al. (2020), Sansoni et al. (2015), and Takamitsu and Meneses (2015) have investigated that the user's acceptance process of ATDs involves both practical and aesthetic aspects of the product, as outlined by Lobach (2001). In this way, for understanding abandonment and its causes, attributes such as appearance and stigma are considered, relating them to the motor, cognitive, communication, and mobility capabilities of the individual, as well as to the environmental factors of the prosthetic-elderly amputee interaction location.

In the face of the abandonment of DTA/prostheses observed in the literature, as well as the physical and psychological characteristics involving the elderly amputee, there is a need to understand if there is also a tendency for prosthetic abandonment among the elderly amputees treated at CER IV, in order to prevent it. In this context, this article presents the investigative process of addressing the demand in AET as a tool for delimiting the problem in a dissertative study involving the interaction of lower limb prostheses and the elderly amputee user in rehabilitation, during the social isolation imposed as a consequence of the SARS-CoV-2 virus.

Locally at CER IV, elderly lower limb amputees make up more than half of the rehabilitation services, distributed across different service sectors, such as the sector for amputees and individuals with congenital deformities (BRASIL, 2021; GEDE, 2021). To determine whether the aforementioned tendency toward abandonment could occur among elderly amputees undergoing rehabilitation locally and thus establish it as the research problem, a

theoretical-documentary and situated research was conducted remotely during the demand instruction phase.

Recently, other researchers have been using ergonomic action as a research tool in Design and Assistive Technology, such as Faustino (2021) and Brondani and Silva (2021). However, despite some design research using ergonomic action to investigate demands, there is still a shortage of studies involving the interaction between prostheses and elderly amputees concerning the issue of DTA abandonment.

2. Methodological Procedures

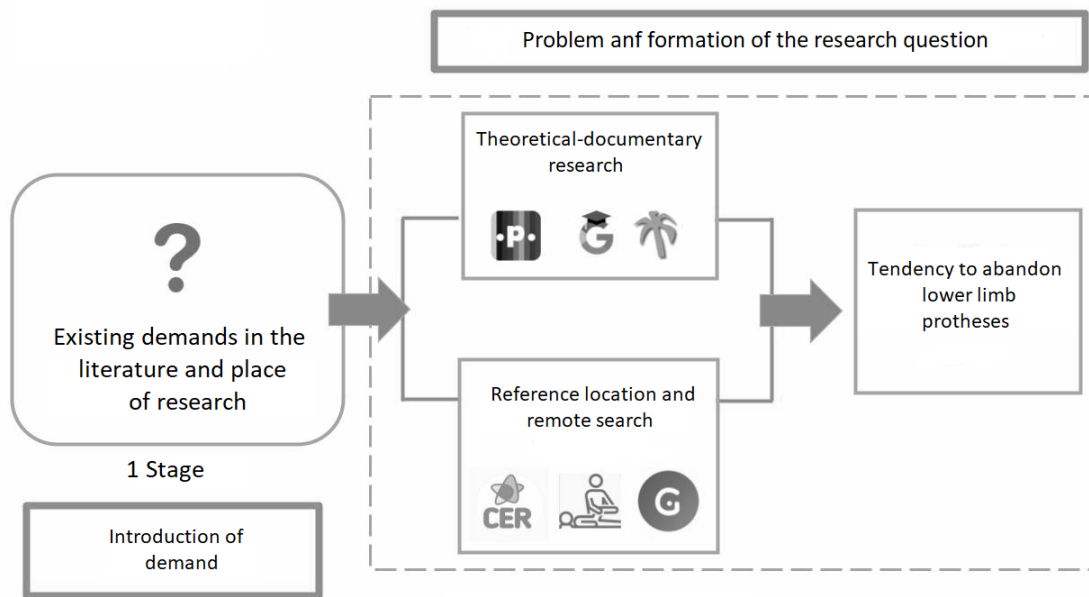
Ergonomic action corresponds to a strategy that utilizes ergonomic criteria and methodologies to identify and implement relevant modifications to the analyzed situation, aiming to adapt it to the needs, abilities, and limitations of users, with the goal of improving the overall efficiency of the system and the health, safety, and well-being of users. The instruction/construction of demands constitutes the first stage of ergonomic analysis, divided into two sub-stages: theoretical-documentary survey and situated research (global analysis), with the objective of identifying existing demands and making them clear and visible (SALDANHA et al, 2012; VIDAL, 2008; VELOSO et al, 2009).

To investigate the scientific needs both in the literature and in the research location, the demand instruction stage from AET (SALDANHA, 2004; VELOSO, 2010; VIDAL, 2008) was used. The study was subdivided into two stages called Theoretical-documentary research and Situated research. The first stage was carried out by searching relevant scientific platforms, collecting articles, dissertations, and theses related to the topic for the construction of a literature review. The second stage, in a hybrid manner (in-person and remote), was conducted through visits to CER IV and online meetings with healthcare professionals involved in the care of elderly amputees. In total, there were 2 (two) remote meetings, 1 (one) guided visit to the research location, 2 (two) conversational actions, and 2 (two) informal conversations via messaging apps, using the following data collection techniques: respectful listening and conversational action, as explained by Saldanha (2004).

2.1 INSTRUCTION/CONSTRUCTION OF DEMAND

The demand outlined in this study is classified as provoked (SALDANHA et al, 2012). According to Veloso et al (2009), this type consists of demand hypotheses related to the research topic, originating from reliable sources and/or real research situations. In this work, such hypotheses were developed through theoretical-documentary research.

Figure 1. Demand Instruction Scheme



Source: Developed by the authors - based on Veloso (2010).

Initially, a systematic literature search of articles on assistive technology and the elderly published in the last five years was conducted using combinations of keyword pairs ('elderly', 'assistive technology', 'abandonment'; 'elderly', 'assistive technology', 'abandonment', 'design'; 'elderly', 'assistive technology', 'abandonment', 'ergonomics') established, employing the boolean operator 'AND' in the following research databases: Periódicos CAPES, Google Scholar, and OasisBr. During the search, 116 articles were found in Periódicos CAPES, 113 in Google Scholar, and 18 articles in OasisBr.

Subsequently, a dynamic reading of the title and objectives of each article was performed to verify if they were related to the study's topic. Only 17 articles met the selection criteria. After the second dynamic reading, only articles dealing with the abandonment of assistive technology were selected, concluding the systematic literature review with 11 articles and extracting the main demands as listed in Table 3 in the results section.

After identifying the existing demand in the literature, an investigation was carried out to determine if these demands could be found at CER IV through situated research. From this perspective, the coordinator of the Design and Ergonomics Study Group (GEDE) at the university responsible for the research scheduled a remote meeting with one of the occupational therapists from the institution, conducted via Google Meet. The research group mentioned brings together both novice researchers (undergraduate and postgraduate students in the Design program at the Federal University of Campina Grande) and experienced researchers (Ph.D. professors from the same department) and focuses on the study of various assistive technologies and ergonomic design themes.

Subsequently, a guided visit and an in-person meeting were conducted with the occupational therapist from the institution, while adhering to the current municipal and state decrees containing guidelines for combating and preventing the COVID-19 pandemic, following the necessary health protocols.

During this visit, the first conversational action was carried out with one of the occupational therapists at the research location. This therapist provided information about the service areas

at the research site and their general characteristics. This conversation was important in guiding the second conversational action, which was held with the physiotherapist from CER IV responsible for the care of elderly amputees. The purpose of this conversation was to discuss the main issues faced by these individuals and their relationship with prosthetics. Both meetings were recorded with permission and subsequently transcribed to identify the existing demands at the location.

As doubts arose regarding the understanding of the collected data, the physiotherapist was contacted through messaging apps to obtain additional information (conversational action I and II). Table 1 provides a detailed account of the facts and experiences of the situated research, relating to the participants who will be further detailed in the social construction (Figure 2 and Table 2).

Table 1. Facts and Experiences Related to Research in the CER IV Setting - Campina Grande, PB.

FACTS AND EXPERIENCES	PARTICIPANTS	PURPOSE	DATE
Meeting with the occupational therapist (remote)	GS e GA (Advising professor), GAE ext (Master's student) + GAE ext 2 (one master's student and undergraduate students from GEDE) + GE (Professor at UAD/UFCG) + GF 1	Presentation of CER IV's Service Departments and Initial Demands	31/07/2021
Guided Tour and Meeting with the Occupational Therapist from GEDE at CER IV	GS e GA (Advising professor) + GAE ext 1 (Master's student) + GAE ext 2 (one master's student from GEDE) + GAE int (director) + GF 1	Familiarization with Service Departments and Identification of Demands	25/01/2021
Remote Meeting of GEDE Members	GAE ext 1 (Master's student) + GAE ext 2	Discussing Points About the Previous Visit	29/01/2021
Conversational Action I - with the Physiotherapists (Remote)	GAE ext 1 (Master's student) + GF 2	Understanding How Rehabilitation Services Are Provided and the Main Challenges Faced	19/02/2021
Conversational Action II - with the Physiotherapists (Remote)	GAE ext 1 (Master's student) + GF 2	Clarify Doubts About the Topic	26/04/2021
Conversational Action III - with the Physiotherapists (Remote)	GAE ext 1 (Master's student) + GF 2	Addressing Questions Regarding the Care of Elderly Amputees	04/05/2021
Informal Conversation IV - with the Physiotherapists (Remote)	GAE ext 1 (Master's student) + GF 2	Addressing Questions About the Care of Elderly Amputees	25/06/2021

Source: Compiled by the authors.

After conducting the situated research, we sought to identify whether any of the demands found in the theoretical-documentary research were repeated throughout the conversational actions with the professionals at CER IV.

2.2 SOCIAL CONSTRUCTION

For this to occur, the investigation must involve not only the ergonomist but also the participation of various social actors who make up the focus work situation. According to Vidal (2008), these individuals are paramount in the process because it is through them that the researcher becomes acquainted with the specific issues related to the problems present in the work situation. Often, it is in these details that the starting point of ergonomic action is found (SALDANHA et al., 2012).

This participatory and multidisciplinary scenario constitutes the social construction that, according to Vidal (2008), aims to collect and validate the information gathered by different individuals involved in a specific work situation. The social actors are organized into groups of operation, which are listed with their respective characteristics in Table 2.

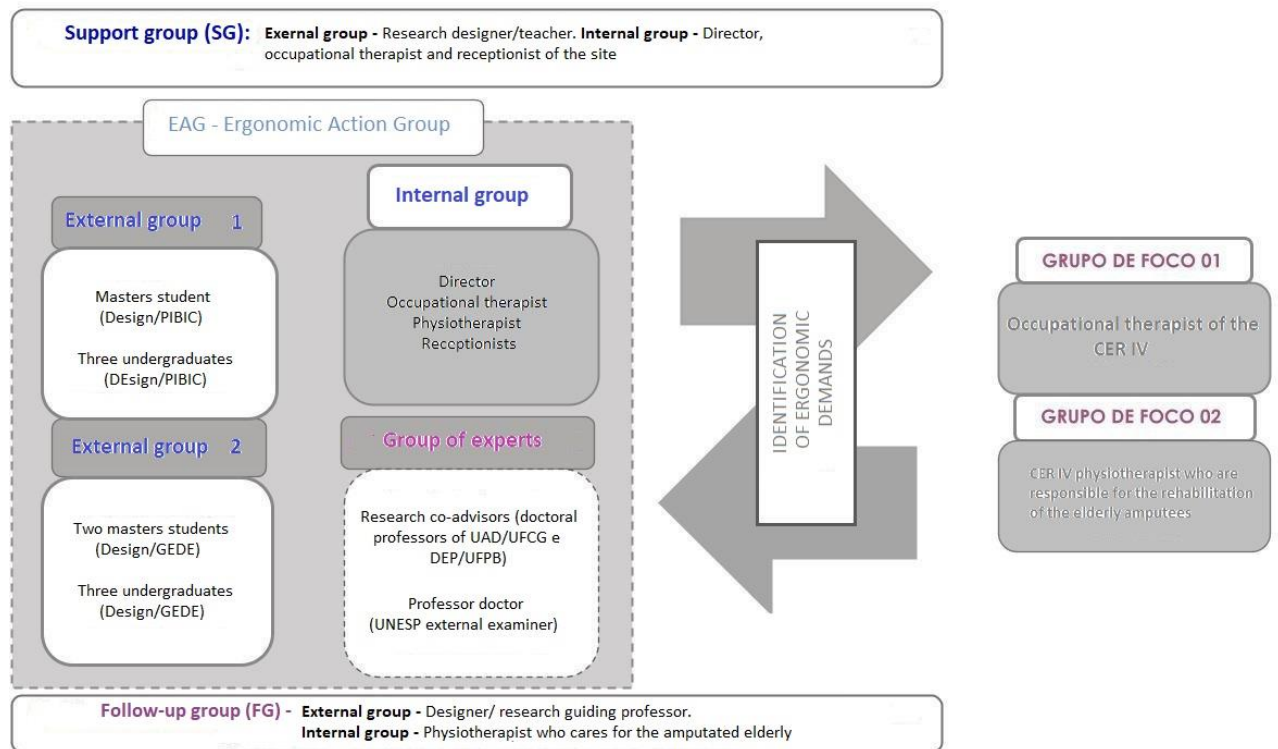
Table 2. Groups that make up the social construction and their respective characteristics.

GROUPS	CHARACTERISTICS
Ergonomic Action Group (GAE)	Formed by individuals directly responsible for the conducted research, the GAE consists of an External Group represented by the faculty and students of GEDE/UFCG and an Internal Group represented by the physiotherapist and occupational therapist from CER IV.
Support Group (GS)	Comprised of individuals who hold managerial decision-making power within CER IV and GEDE, these include the research advisor, occupational therapist, director, and receptionists of CER IV.
Monitoring Group (GA)	Composed of individuals with the authority to make technical decisions related to CER IV and the research development, these individuals include the research advisor and the physiotherapist from CER IV.
Focus Groups (GF's)	These are individuals directly related to the focus situation under analysis, CER IV, involved in the rehabilitation care of elderly amputees. The members of the focus groups provided information, feedback, and validations throughout the process of instruction/construction of ergonomic demands linked to this project. They are the occupational therapist and physiotherapist.
Expert Group (GE)	These are individuals with specific knowledge about the topic and who have occasional participation in the project. They are the study's co-advisors (professors from UAD/UFCG, DEP/UFPB,

Source: Compiled by the authors - based on Saldanha et al. (2012) and Vidal (2008).

Figure 2 depicts the social construction device carried out during the demand instruction at CER IV:

Figure 2. Social construction device



Source: Prepared by the authors- based on Vidal (2008) e Veloso (2010).

During the demand instruction, two focus groups were formed to analyze the work situation in question: FG1, which pertained to the initial contact with the topic and the research location, characterizing a general approach among the members of the Design and Ergonomics study group and the occupational therapist. Subsequently, FG2 aimed to understand the main issues involving elderly amputees and lower limb prostheses, establishing a more specific investigation between the master's student and the physiotherapists at CER IV who treat elderly amputees.

In both groups, data collection was carried out through respectful listening between the members of the mentioned study group and the master's student, with the occupational therapist and the physiotherapist from CER IV responsible for treating elderly amputees, respectively. Over time, questions about the topic arose, and conversational actions developed.

Furthermore, throughout the process involving situated research, the participation of all those involved in the demand instruction stage was of paramount importance. Even in a pandemic context, it was possible to validate the demands by adapting data collection tools to the remote context. Without the social construction involving the focus groups, it would not have been possible, in the current context, to validate and provide practical guidance for scientific research that could contribute to future solutions corresponding to the reality of the research location.

3. RESULTS AND DISCUSSIONS

Table 3 provides an overview of the articles found in the literature review, highlighting authors, publication year, journal, and the demands related to the use and abandonment of assistive technologies.

Table 3. Articles found in the systematic literature review, related to the demands.

AUTHORS	TITLE	DATABA SE	IDENTIFIED DEMANDS
Porsani et al (2020)	Emotion and Aesthetics: Analysis of Customizable Transtibial Prosthesis Covers Using the Gew Tool.	<i>Google Scholar</i>	The need for the production of prostheses with a more elaborate and attractive aesthetic for the user in consideration, contributing to the solution of one of the most recurring problems: prosthesis abandonment.
Bortolan et al (2020)	Evaluation of AFO Orthosis Through a Semantic Differential Scale	<i>Google Scholar</i>	The need to consider practical, aesthetic, and symbolic aspects together in the design process of devices, as well as conducting user interaction tests with end-users.
Silva and Sader (2019)	The functional and symbolic relationships of the object in design	Periódicos CAPES	The need to relate the emotional aspects of the user with the practical, aesthetic, and symbolic aspects of the product in order to encourage its use.
Sugawara et al (2018)	<i>Abandonment of assistive products: assessing abandonment levels and factors that impact on it</i>	<i>Google Scholar</i>	"Emphasizes the need to consider a user-centered approach (both their awareness of the process and individual position), as well as post-prosthetic follow-up.
Merino et al (2018)	Contributions of Design in Promoting Autonomy in a Psychiatric Hospital in Santa Catarina	<i>Google Scholar</i>	The need to observe the user using the device in the usage environment in order to list the demands and propose more appropriate and specific solutions.
Pichler and Merino (2017)	Assistive Technology Design with a User-Centered Approach: Diagrams of Product-User-Context Interaction	<i>Google Scholar</i>	Investing in user-centered design processes for ATDs, also considering the particularities of the usage context, as a way to reduce associated abandonment rates.
Gradim et al (2016)	Mapping of Assistive Technology Resources Used by the Elderly.	<i>Oasis Br</i>	The need for studies that highlight the relationship between assistive technology devices and the performance demands of the elderly, due to the observed abandonment.
Boiani, Medola and Paschoarelli (2016)	Elderly Perception of Frontal Walker Usage: Contributions to Assistive Technology and Ergonomic Design Studies	<i>Oasis Br</i>	The need to invest in aspects of assistive devices that cause discomfort and pain to the elderly during use.
Sansoni et al (2015)	<i>The Aesthetic Appeal of Prosthetic Limbs and the Uncanny Valley: The Role of Personal Characteristics in Attraction</i>	Periódicos CAPES	The need to consider aesthetic aspects, particularly for the future user, thereby increasing the chances and potential for satisfaction."

Lanutti et al (2015)	<i>The Significance of Manual Wheelchairs: A Comparative Study on Male and Female Users</i>	Periódicos CAPES	The need for studies that consider not only practical aspects but also aesthetic and symbolic aspects in the user-assistive device relationship, taking into account gender-specific nuances in future studies of a similar nature.
Costa et al (2015)	Assistive Technology Devices: Factors Related to Abandonment	<i>Google Scholar</i>	The need for suggestions for effective outcomes in reducing abandonment for each type of assistive device mentioned, including prostheses.

Source: Compiled by the authors.

Costa et al. (2015) and Sugawara et al. (2018) point out that the abandonment of ATDs constitutes one of the main issues in the field, primarily affecting devices such as wheelchairs and prostheses. The latter, related to lower limbs, has the highest abandonment rates. Moreover, it stems from various factors related to the user-product interaction, such as dissatisfaction, usage difficulties, and physical aspects of the user, for example.

Pichler and Merino (2017) identify the failure to meet user needs and expectations as one of the main reasons for ATD abandonment. Gradim et al. (2016) highlight the inefficiency of AT products in performing daily activities, as reported by the elderly individuals investigated in their research.

Lanutti et al. (2015), Sansoni et al. (2015), Boiani, Medola, and Paschoarelli (2016), Pichler and Merino (2017), Bortolan et al. (2020), and Porsani et al. (2020) emphasized that the practical, aesthetic, and symbolic attributes of AT products and how these aspects contribute to the user's acceptance of prostheses and related assistive devices, thereby preventing abandonment. It was found that, although practical aspects are essential in the use of assistive products, aesthetic and symbolic elements are important for promoting continued use. However, during the literature review, it was observed that most investigations of this nature focused on devices such as walkers and wheelchairs. Only one study related to lower limb prostheses was found, and neither this study nor the others mentioned above included lower limb amputees as users.

In the situated research, during the first remote meeting with the occupational therapist, she presented the service sectors to the group members via slides, discussing the prostheses and orthoses prescribed for the children, adults, and elderly individuals served at the facility. Subsequently, during the first conversational action, it was determined that the amputees and individuals with congenital limb differences sector is primarily composed of adults and the elderly. Additionally, some examples of mobility aids used in the rehabilitation treatment were identified, as shown in Figure 3.

Figure 3. Mobility aids used in rehabilitation (pre-prosthetic and prosthetic stages)



Source: The authors

In the second conversational action, aspects that can affect the acceptance of the prosthesis were highlighted, such as the lack of motivation of the elderly individual to begin treatment, high dependency for mobility outside the home, and during the process of fitting/removing the prosthesis, as evidenced in one of the excerpts from the physiotherapist's statements:

"So... what they complain about the most is the issue of depending on someone, right? (...) At home, no. At home, they get a chair... they move around, they manage. But, to go out, to deal with something, to go to the doctor, to go somewhere, they have this dependency on someone."

Based on the experience of the physiotherapist at CER IV, the main issues related to the topic that stood out were the inclination of the elderly to abandon the prosthesis, which aligns with the demand found in the literature, as shown in another excerpt:

"...there are 'n' cases, right? The patient comes, goes through this whole process..., receives the prosthesis, we instruct the patient to walk with the prosthesis and everything, but when they get home, they don't use the prosthesis! Because at home, there's no one to help them put on the prosthesis... so the prosthesis just sits there..."

According to her, the reasons are associated with general factors such as reduced musculoskeletal capabilities - linked to advanced age and comorbidities that led to amputation - as well as a weakened emotional state due to the procedure and the established habit of using another DTA and preferring it, in accordance with what was discussed in other parts of the conversation with the physiotherapist:

"...it also happens that the patient is referred by the doctor but doesn't adapt to the treatment and gives up due to insecurity and... not accepting the condition they are in, being there more for the sake of their family members..."

"...it happens that the patient has become accustomed to using another device, like a wheelchair... they say it's faster to move with it than with the prosthesis, so they leave it aside..."

"...in the elderly, most of the time, the treatment is slower and more costly to prosthetize... because of their low muscle

conditioning... but sometimes they also have good conditioning and don't even need to do the initial exercises..."

4. CONCLUSION

The abandonment of prostheses is a topic in assistive technology that has been relatively unexplored by researchers, especially when it comes to lower limb prostheses involving elderly individuals as users. The factors associated with the non-acceptance of the device, such as the failure to understand the user's needs and expectations, are related not only to the investigation of individual characteristics but also to practical, aesthetic, and symbolic aspects of the product and the usage environment.

The investigation of the existing demands in the amputee and congenital malformation sector of CER IV, through social construction, has been of paramount importance in discovering the trend of DTA abandonment in the research site, especially in the context of the limiting effects of the pandemic on social interaction. As a result, the research was directed towards exploring the local recurrence of the issue of abandonment found in the literature, comparing the data collected from literature with those obtained from semi-structured interviews.

Parte superior do formulário

Without the contribution and collaborative partnership between the researchers in the research group and the professionals at the local site, the situated research would not have been realized, and the definition of a problem closely aligned with the reality of CER IV would have been compromised. In this way, the social construction intrinsic to Assistive Technology (AET) associated with technological resources helped in the realization of addressing the demand in a scenario of limited social interactions, demonstrating the feasibility of applying this stage of ergonomic action with participants at a long distance. In this regard, the pandemic expanded the horizons of Design and Ergonomics researchers regarding new possibilities for studies and data collection in places and/or institutions in other regions or countries.

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