



## IDENTIFICATION OF ERGONOMIC DEMANDS RELATED TO THE USE/ABANDONMENT OF LOWER DENTURES 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 Specialized Center for Rehabilitation (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

In the last eight years, the number of elderly people has increased by 20%, demonstrating the trend of population aging of the Brazilian population (AGÊNCIA BRASIL, 2020). Along with this, there is an increase in cases of lower limb amputations among the elderly, and consequently, the growth in the need to use assistive technology devices (ATD). These products aim to contribute to the restoration of the individual's autonomy to carry out activities of daily living aiming at the return of people with reduced mobility to an active social life (BIFFI *et al*, 2017; BOIANI, MEDOLA AND PASCHOARELLI, 2016; COSTA *et al*, 2015; DIOGO, 2003).

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Despite the growing need for the use of assistive devices, demonstrated by the increase in the elderly population and the number of lower limb amputees, there has been an increase in the rates of abandonment of their use. According to data from WHO (2016), about 75% of DTAs are abandoned by users. According to Sugawara *et al* (2018), prostheses for the lower limbs are among the DTAs that have one of the highest dropout rates.

The causes are associated with several factors. According to Federici *et al* (2016), it highlights the failure to meet the real needs and expectations of the user. Pichler and Merino (2017) expose that assistive technology devices that meet the needs and expectations of the user, enable the user's experience and positive perceptions of the same in the interaction, reducing the possibilities of abandonment and increasing those of satisfaction and prolongation of use.

The practical, aesthetic and symbolic aspects mentioned by Lobach (2001) influence the acceptance of AT devices by the user; one to a greater degree than the other, depending on the type and characteristics of the product/device considered (LANUTTI *et al*, 2015; SILVA and SADER, 2019). When it comes to orthoses and prostheses, Bortolan *et al* (2020) and Sansoni *et al* (2015) point out that although the practical function is of great importance, when considering the physically disabled and elderly user, the symbolic and aesthetic function also considerably influence the acceptance of these devices by the individual.

Considering this logic, low acceptance can culminate in product abandonment, which occurs when it does not adequately meet the user's needs and expectations regarding practical attributes - related to use - aesthetic - linked to appearance - and symbolic - 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 process of acceptance of DTAs by the user involves both the practical and the aesthetic and symbolic aspects of the product, listed by Lobach (2001). Thus, in order to understand abandonment and causes, attributes such as appearance and stigma are considered, relating them to the individual's motor, cognitive communication and mobility capacities, as well as to the environmental factors of the prosthesis-amputee elderly interaction site.

In view of the abandonment of ATD/prostheses verified in the literature, as well as the physical-psychological characteristics involving the amputee elderly, there is a need to



understand whether there is also a tendency to abandon prostheses among the amputee elderly treated at the local CER IV, in order to prevent it. In this context, this article presents the investigative process of instruction of the demand in AET as an instrument for the delimitation of the problem of an essay study involving the interaction of lower dentures and the elderly amputee user in rehabilitation, during the social isolation imposed as a consequence of the SARS-CoV-2 virus.

Locally in CER IV, elderly lower limb amputees account for more than half of the rehabilitation care for prosthetics, distributed in different care sectors, such as the amputee and malformed sector (BRASIL, 2021; GEDE, 2021). To verify whether the tendency to abandonment mentioned could occur among the elderly amputees undergoing rehabilitation locally, and thus establish it as a problem of the investigation, a theoretical-documentary and situated research was carried out regarding the stage of instruction of the demand remotely.

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

## 2. METHODOLOGICAL PROCEDURES

Ergonomic action corresponds to a strategy that uses ergonomic criteria and methodologies to identify and enable modifications pertinent to the analyzed situation, seeking to adapt it to the needs, abilities and limitations of users, aiming at the overall efficiency of the system and the health, safety and well-being of users. The instruction/construction of demands is 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, making them clear and visible (SALDANHA *et al*, 2012; VIDAL, 2008; VELOSO *et al*, 2009).

For the investigation of scientific needs both in the literature and in the research site, the stage of instruction of the demand, originating from the AET (SALDANHA, 2004; VELOSO, 2010; VIDAL, 2008). The study was subdivided into two stages called: Theoretical-documentary research and Situated research. The first was carried out through a search on pertinent scientific platforms, collecting articles, dissertations and related theses for the

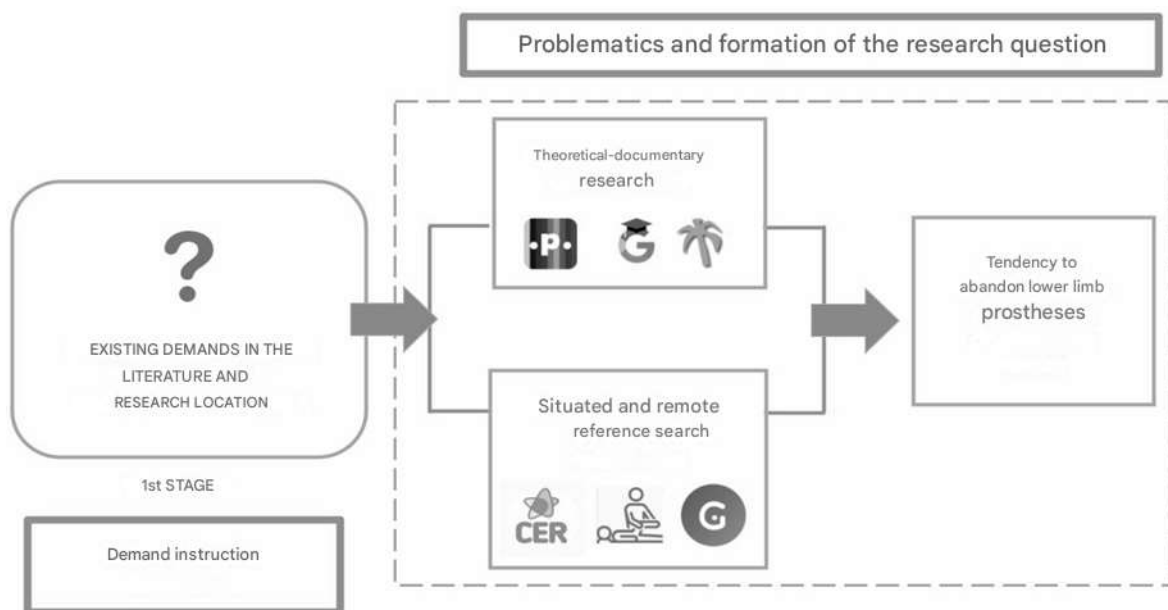


construction of a bibliographic review on the subject. The second, in a hybrid way (face-to-face and remote), was carried out through visits to CER IV and *online* meetings with health professionals involved in the rehabilitation care of the elderly amputee. In all, there were 2 (two) remote meetings, 1 (one) guided tour of the research site, 2 (two) conversational actions and 2 (two) informal conversations, via messaging applications, using the following techniques for data collection: respectful listening and conversational action, as explained by Saldanha (2004).

## 2.1. Demand Education/Construction

The demand explained in this study is classified as provoked (SALDANHA *et al*, 2012). According to Veloso *et al* (2009), this type is constituted by hypotheses of demand on the theme under investigation, arising from reliable sources and/or real research situation. In this work, such hypotheses were elaborated through theoretical-documentary research

**Figure 1.** Demand instruction scheme



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

Initially, a systematic bibliographic search of articles on ED and the elderly, published in the last five years, was carried out based on combinations of pairs of keywords ('elderly', 'assistive technology', 'abandonment'; 'elderly', 'assistive technology', 'abandonment', 'design'; 'elderly', 'assistive technology', 'abandonment', 'ergonomics') established, using the Boolean



operator 'AND' in the following research databases: CAPES, *Google Scholar* and *OasisBr journals*. During the search, 116 articles were found in CAPES Journals, 113 in *Google Scholar* and 18 articles in *OasisBr*.

Then, the title and objective of each article were dynamically read, verifying whether they were related to the theme of study. Only 17 articles met the established selection criteria. After the second dynamic reading, only the articles that dealt with the abandonment of assistive technology were selected, ending the systematic bibliographic study with 11 articles, extracting the main demands as listed in Table 3, in the results section.

After verifying the existing demand in the literature, we sought to investigate the possibility of repeating these in CER IV, through situated research. From this perspective, the coordinator of the study group in Design and Ergonomics (GEDE) of the university responsible for the research, scheduled a remote meeting with one of the institution's occupational therapists, held via *Google Meet*. The aforementioned research group brings together beginner researchers (undergraduate and graduate students of the Design courses at the Federal University of Campina Grande) and experienced (professors with PhDs from the same department) and focuses on the study of themes that address various assistive technologies and ergonomic design.

Subsequently, a guided tour and an *on-site* meeting were held with the institution's occupational therapist, observing the current municipal and state decrees, which contained the guidelines for combating and preventing the COVID-19 pandemic, following the necessary health protocols.

In this one, the first conversational action was performed with one of the occupational therapists of the place, who explained about the service sectors of the research site and their general characteristics, in addition to being important to guide the second conversational action, carried out with the physiotherapist of CER IV, responsible for the care of elderly amputees, in order to discuss the main problems of these and their relationship with the prosthesis. Both meetings were recorded with authorization and later transcribed in order to identify the existing demands in the place.

As doubts arose regarding the understanding of the data collected, the physiotherapist was contacted via messaging application, in search of additional information (conversational action I and II). Table 1 presents a breakdown of the facts and experiences of the situated research, listing the participants who will be better detailed in the social construction (Figure 2 and Table 2).

**Table 1.** Facts and experiences related to the research in the focus situation in CER IV

FATOS E VIVÊNCIAS	PARTICIPANTES	FINALIDADE	DATA
Reunião com a terapeuta ocupacional (remota)	GS e GA (professora orientadora), GAE ext 1 (mestranda) + GAE ext 2 (um mestrando e graduandos do GEDE) + GE (professor da UAD/UFCG) + GF 1	Apresentação dos setores de atendimento do CER IV e demandas iniciais	31/07/2021
Visita guiada e reunião com a terapeuta ocupacional do GEDE ao CER IV	GS e GA (professora orientadora) + GAE ext 1 (mestranda) + GAE ext 2 (um mestrando do GEDE) + GAE int (diretor) + GF 1	Conhecer os setores de atendimento e identificação de demandas	25/01/2021
Reunião dos integrantes do GEDE (remota)	GAE ext 1 (mestranda) + GAE ext 2	Discutir pontos sobre a visita anterior	29/01/2021
Ação conversacional I - com os fisioterapeutas (remota)	GAE ext 1 (mestranda) + GF 2	Conhecer como acontece os atendimentos de reabilitação e os principais problemas enfrentados	19/02/2021
Ação conversacional II - com os fisioterapeutas (remota)	GAE ext 1 (mestranda) + GF 2	Tirar dúvidas sobre a temática	26/04/2021
Ação conversacional III - com os fisioterapeutas (remota)	GAE ext 1 (mestranda) + GF 2	Tirar dúvidas sobre o atendimento de idosos amputados	04/05/2021
Conversa informal IV - com os fisioterapeutas (remota)	GAE ext 1 (mestranda) + GF 2	Tirar dúvidas sobre o atendimento de idosos amputados	25/06/2021

**Source:** Prepared by the authors

After carrying out the situated research, it was sought to identify whether any of the demands found in the theoretical-documentary research were repeated throughout the conversational actions with the professionals of CER IV.

## 2.2. Social Construction

For it to occur, the investigation must involve not only the ergonomist, but also count on the participation of the various social actors that make up the work situation in focus. According to Vidal (2008), these individuals are essential in the process, because it is through them that the researcher knows the particularities related to the problems present in the work situation. In these details, the starting point of ergonomic action is often found (SALDANHA *et al.*, 2012).



This participatory and multidisciplinary scenario is part of the social construction that, according to Vidal (2008), has as its purpose the survey and validation of the information collected by different individuals involved in a specific work situation. The social actors are organized into action groups that are listed, with their respective characteristics in Table 2:

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

GRUPOS	CARACTERÍSTICAS
<b>Grupo de Ação Ergonômica (GAE)</b>	Formado pelas pessoas responsáveis diretamente pela pesquisa realizada. O GAE é composto por um Grupo Externo, representado pelos docentes e discentes do GEDE/UFCG, e por um Grupo Interno, representado pelo fisioterapeuta e terapeuta ocupacional do CER IV.
<b>Grupo de Suporte (GS)</b>	Formado por pessoas que detêm o poder de decisão gerencial no CER IV e no GEDE. São elas: professora orientadora da pesquisa, terapeuta ocupacional, diretor e recepcionistas do CER IV.
<b>Grupo de Acompanhamento (GA)</b>	Formado por pessoas que têm autoridade para tomar decisões técnicas relativas ao CER IV e ao desenvolvimento da pesquisa. São elas: professora orientadora da pesquisa e fisioterapeuta do CER IV.
<b>Grupos de Foco (GF's)</b>	Pessoas que estão relacionadas diretamente com a situação de foco em análise, CER IV, envolvidos no atendimento de reabilitação do idoso amputado. Os integrantes dos grupos de foco participaram do fornecimento das informações, restituições e validações ao longo do processo de instrução/construção de demandas ergonômicas vinculados a este projeto. São eles: terapeuta ocupacional e fisioterapeuta.
<b>Grupo de Especialistas (GE)</b>	Pessoas que detêm conhecimentos específicos sobre a temática e que possuem participação pontual no projeto. São elas: Co-orientadores do estudo (professores da UAD/UFCG, e DEP/UFPB e FAAC/UNESP).

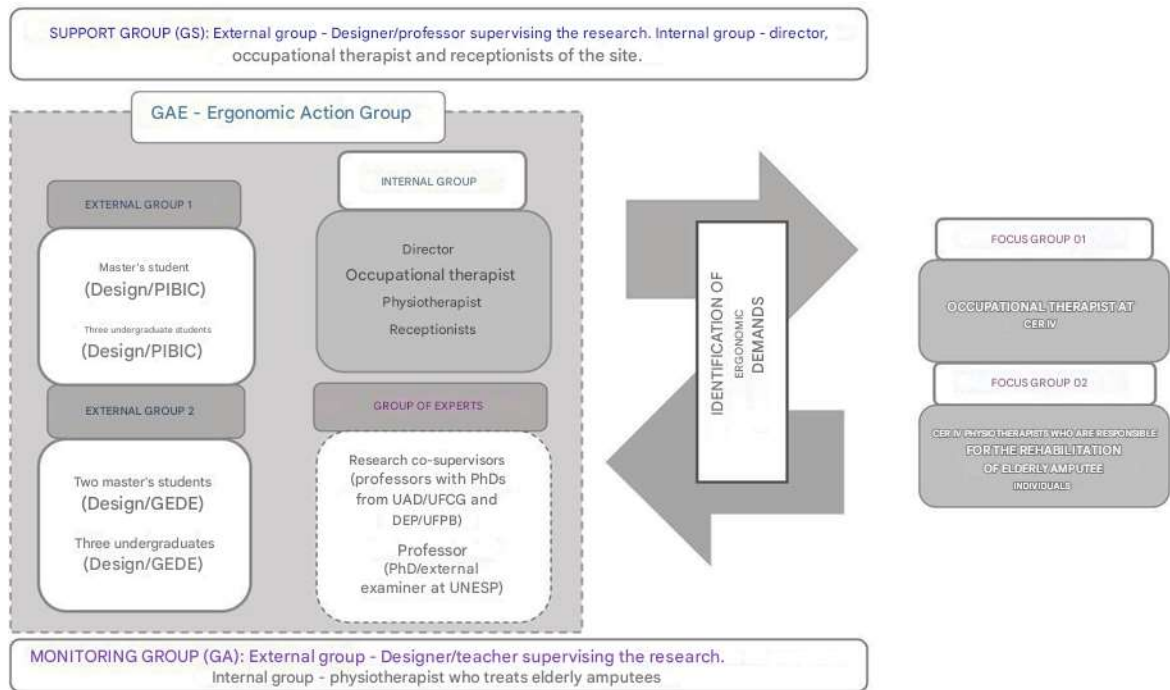
**Source:** Prepared by the authors - based on Saldanha *et al* (2012) and Vidal (2008).

Figure 2 shows the social construction device carried out during the instruction of the demand in CER IV:





**Figure 2.** Social Construction Device



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

During the instruction of the demand, two focus groups were formed to analyze the work situation addressed: FG1, referring to the initial contact with the theme and place of research, characterizing a general approach between the members of the study group in Design and Ergonomics and the occupational therapist. Subsequently, FG2 aimed to understand the main problems involving the elderly amputee and the prosthesis for the lower limb, establishing a more specific investigation between the master's student and the physiotherapists of CER IV who care for the elderly amputees.

In both groups, data collection was carried out through respectful listening between the members of the aforementioned study group and the master's student, with the occupational therapist and the physiotherapist of the local CER IV responsible for the care of the amputee elderly, respectively. Over time, doubts about the theme arose, and conversational actions developed.

Furthermore, throughout the process involving the situated research, the participation of all those involved in the instruction stage of the demand was of paramount importance. In it, even in a pandemic context, it was possible to validate the demands by adapting the collection tools to the remote context. Without the social construction involving the focus groups, it would not be possible, in the current context, to validate and provide practical directions for a scientific





investigation that would contribute to a future resolution of demands corresponding to the reality of the research site.

### **3. RESULTS AND DISCUSSIONS**

Table 3 presents a global view of the articles found in the literature review, highlighting authors, year of publication, journal, and the demands related to the use and abandonment of assistive technologies.



**Table 3.** Articles found in the systematic bibliographic study carried out, relating to the demands

AUTORES	TÍTULO	BASE DE DADOS	DEMANDAS IDENTIFICADAS
<b>Porsani et al (2020)</b>	Emoção e Estética: Análise de Invólucros Customizáveis de Próteses Transtibiais Por Meio da Ferramenta <i>Gew</i>	<i>Google Scholar</i>	Necessidade da produção de próteses com estética mais elaborada e atrativa para o usuário considerado, contribuindo para a solução de um dos problemas mais recorrentes: o abandono das próteses.
<b>Bortolan et al (2020)</b>	Avaliação de Órtese AFO Por Meio de uma Escala de Diferencial Semântico	<i>Google Scholar</i>	Necessidade de considerar, de forma conjunta, os aspectos práticos, estéticos e simbólicos no processo de projeto de dispositivos, bem como realizar testes de interação de uso nos usuários finais
<b>Silva e Sader (2019)</b>	As relações funcionais e simbólicas do objeto no design	Periódicos CAPES	Necessidade de relacionar os aspectos emocionais do usuário com os práticos, estéticos e simbólicos do produto, a fim de estimular o uso
<b>Sugawara et al (2018)</b>	<i>Abandonment of assistive products: assessing abandonment levels and factors that impact on it</i>	<i>Google Scholar</i>	Enfatiza a necessidade de considerar uma abordagem centrada no usuário (tanto a sua consciência do processo quanto a posição individual), bem como o acompanhamento pós protetização.
<b>Merino et al (2018)</b>	Contribuições do Design na promoção da autonomia em um Hospital Psiquiátrico de Santa Catarina	<i>Google Scholar</i>	Necessidade de observar o usuário utilizando o dispositivo no ambiente de uso, a fim de elencar as demandas, propondo soluções mais adequadas e pontuais
<b>Pichler e Merino (2017)</b>	Projeto de Tecnologias Assistivas com abordagem centrada no usuário: diagramas da interação produto-usuário-contexto	<i>Google Scholar</i>	Investir em processos de projeto de DTAs centrados no usuário, considerando também as particularidades do contexto de uso, como maneira de reduzir os índices de abandono associados.
<b>Gradim et al (2016)</b>	Mapeamento de recursos de tecnologia assistiva utilizados por idosos	<i>Oasis Br</i>	Necessidade de estudos que evidenciem a relação dos dispositivos de tecnologia assistiva com as demandas de desempenho dos idosos, devido ao abandono verificado.
<b>Boiani, Medola e Paschoarelli (2016)</b>	Percepção de idosos sobre o uso de andador frontal: contribuições para os estudos de Tecnologias Assistivas e Design Ergonômico	<i>Oasis Br</i>	Necessidade de investir em aspectos dos dispositivos assistivos que incomodam e causam dor ao idoso durante o uso
<b>Sanconi et al (2015)</b>	<i>The Aesthetic Appeal of Prosthetic Limbs and the Uncanny Valley: The Role of Personal Characteristics in Attraction</i>	Periódicos CAPES	Necessidade de considerar os aspectos estéticos, de maneira particular, para o futuro usuário, aumentando as chances e potencial de satisfação.
<b>Lanutti et al (2015)</b>	<i>The Significance of Manual Wheelchairs: A Comparative Study on Male and Female Users</i>	Periódicos CAPES	Necessidade de estudos que considerem, não apenas os aspectos práticos, mas também estéticos e simbólicos na relação usuário-dispositivo assistivo, observando as particularidades de gênero em estudos futuros de mesma natureza.
<b>Costa et al (2015)</b>	Dispositivos de tecnologia assistiva: fatores relacionados ao abandono	<i>Google Scholar</i>	Necessidade de sugestões para resultado efetivos, na redução do abandono, para cada tipo de dispositivo assistivo citado, inclusive as próteses.

**Source:** Prepared by the authors

Costa et al (2015) and Sugawara et al (2018) point out that the abandonment of DTAs is one of the main problems in the area, affecting devices such as wheelchairs and prostheses



in greater part. The latter, related to the lower limbs, has the highest rates of abandonment. In addition, it comes from several factors related to the user-product interaction, such as dissatisfaction, difficulties in use, and physical aspects of the user, for example.

Pichler and Merino (2017) point to the failure to meet the needs and expectations of the user as one of the main reasons for the abandonment of DTAs. Gradim *et al* (2016) highlights the inefficiency of AT products for the execution of daily activities, as reported by the elderly 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), Porsani *et al* (2020) emphasized that the practical, aesthetic and symbolic attributes of the AT product and how such aspects contribute to the acceptance of prostheses and related assistive devices by the user, preventing abandonment. It was found that, although the practical aspects are essential in the use of assistive products, the aesthetic and symbolic aspects are important for the promotion of continuity of use. However, during the prospection of articles, it was found that most investigations of this nature correspond to devices such as walkers and wheelchairs. Only one study related to lower limb prosthesis was found, in which neither this nor the previous ones presented the elderly lower limb amputee as a user.

In the research situated, during the first remote meeting with the occupational therapist, she presented via *slides*, the sectors of care to the members of the group, talking about the prostheses and orthoses prescribed for children, adults and the elderly assisted at the site. Subsequently, in the first conversational action, it was found that the amputee and malformed sector is mostly formed by adults and the elderly, and some examples of mobility aids used in rehabilitation treatment were known, 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 pointed out, such as: the lack of motivation of the elderly to start the treatment, high dependence for locomotion 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 take a chair... to and fro, they turn around. But to go out, to solve something, to go to the doctor, to some 'corner', they have this dependence on someone."*

Based on the experience of the physiotherapist of CER IV, the inclination to abandon the prosthesis by the elderly was highlighted as the main problems in relation to the theme, corroborating the demand found in the literature, as shown in another excerpt:

*"(...) There are 'n' cases, right? From the patient to come, go through this whole process..., receive the prosthesis, we guide the patient to walk with the prosthesis, everything else and when he gets home, he doesn't use the prosthesis! Because at home, there is no one to help put the prosthesis (...) then the prosthesis is thrown there..."*

The reasons, according to her, are associated with general factors such as: reduction of musculoskeletal capacities - linked to advanced age and comorbidities that led to amputation - as well as a weakened state of mind due to the procedure and also the established habit of using another DTA and preferring it, in accordance with what is exposed in other excerpts of conversations with the physiotherapist:

*"(...) It also happens that the patient is referred by the doctor, but does not adapt to the treatment and gives up, due to insecurity and... for not accepting the condition in which he is, being there more for his family (...)"*



*"(...) it happens that the patient has become accustomed to the use of another device, such as the wheelchair (...) says that it is faster to move with it than with the prosthesis, leaving it alone (...)"*

*"(...) In the elderly, most of the time, the treatment is slower and more expensive to prosthetize... due to his low muscular conditioning (...) but sometimes it also happens that he has good conditioning and does not even need to do the initial exercises (...)"*

#### 4. CONCLUSION

The abandonment of prostheses is a theme in AT that has not yet been explored by researchers, especially when it comes to prostheses for the lower limbs involving, as a user, the elderly person. 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 the individual's particularities, but also to the practical, aesthetic and symbolic aspects of the product and the environment of use.

The investigation of the existing demands in the amputee and malformed sector of the local CER IV, through social construction, was of paramount importance for the discovery of the tendency to abandon DTAs at the research site, especially in the face of the pandemic scenario limiting social interaction. Thus, the research was directed by inquiring about the local repetition of the problem of abandonment found in the literature, confronting the data collected in the literature with those from semi-structured interviews.

Without the contribution and collective partnership between the researchers of the research group and the professionals of the place, the situated research would not be carried out and the definition of a credible problem the reality of the local CER IV would be compromised. Thus, the social construction intrinsic to the ETS associated with technological resources helped in the realization of the instruction of the demand in a scenario of limited social interactions, demonstrating that it is possible to apply this stage of ergonomic action with participants at a long distance. In this, the pandemic has made it possible to broaden the horizons of researchers in Design and Ergonomics regarding new possibilities for studies and data collection in places and/or institutions in other regions or countries.

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