Solutions for elderly people: an overview of technology developed

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ABSTRACT

The aging of the world population is a challenge for governments and the market. There were, in 2021, 761 million people aged 65 or over; this number is expected to increase. This phenomenon is directly accompanied by a decrease in the organism's functional capacity, such as motor capacity. One way to increase the general quality of life of Old People with Motor Disabilities and help them regain some control and live independently is to offer products and services that solve their main problems. The objective of this study was to search for technologies (inventions and utility models) for this population that have been registered in recent years in Brazil but also in Europe and USA. The patent search was conducted on the electronic platforms of the patent offices in Brazil and Europe. 337 registers were found and 55 results met the inclusion and exclusion criteria. The results show an improvement in the number of registers in the last decade, however, this can be considered little if we look at the size of the population and its challenges.

Keywords: Aging; Elderly; Old people; Disabilities; Patents.
RESUMO
O envelhecimento da população mundial é um desafio para os governos e para o mercado. Havia, em 2021, 761 milhões de pessoas com 65 anos ou mais; a expectativa é que esse número aumente. Esse fenômeno é acompanhado diretamente pela diminuição da capacidade funcional do organismo, como a capacidade motora. Uma forma de aumentar a qualidade de vida geral dos Idosos com Deficiência Motora e ajudá-los a recuperar algum controle e a viver de forma independente é oferecer produtos e serviços que resolvam os seus principais problemas. O objetivo deste estudo foi buscar tecnologias (invenções e modelos de utilidade) para esta população que tenham sido depositadas nos últimos anos no Brasil, mas também na Europa e nos EUA. A busca de patentes foi realizada nas plataformas eletrônicas dos escritórios de patentes do Brasil e da Europa. Foram encontrados 337 depósitos e 55 registros atenderam aos critérios de inclusão e exclusão. Os resultados mostram uma melhora no número de depósitos na última década, porém, isso pode ser considerado pouco se olharmos o tamanho da população e seus desafios.

Palavras-chave: Envelhecimento; Idosos; Velhos; Deficiências; Patentes.

INTRODUCTION

The aging of the world population is a challenge for governments and the market. In 2021 there were 761 million people aged 65 or over (UN, 2023), and Nations United (UN) concluded that this number will double by 2050. Life expectancy (i.e. aging) was a wish of many past generations (Vaupel et al., 2021), a long life was experienced by some throughout the history and has been achieved since the last century (Thanе, 2000). Karppinen et al. (2016) showed that 32.9% of people aged between 75 and 96 desired to reach 100 years old. Huohvanainen et al. (2012) verified that “one-third of relatively well-functioning home-dwelling older men wanted to live to aged 100”. Brandão et al. (2019) found that 56.5% of people (aged between 25 and 86) who experienced a close relationship with an elderly person wanted to live to an advanced age. According to Scott (2021), the comparison of the risk of death in the United Kingdom decreased between 1950 and 2018; the average age at death is 78 years, the median is 83 years and the mode is 87 years. So the chances of living to age 90 or beyond have increased substantially. However, the people’s true desire is not necessarily to improve their lifetime, but to live properly and with the same quality of life they had when they were young. This because, according Lang et al. (2007) stated, “(...) the dysfunctional state of many of the oldest-old people is widely known and may have adverse motivational consequences”.
While medicine and genetic engineering are not developed to this stage – to provide older people the same quality of life they had when they were young –, product engineering and the market (silver economy) should offer some alternatives to allow people to lead independent and good quality lives during this prolonged period. For this happen it is necessary to create ways in which old people can live without the care of others in their family home environment, being autonomous to conduct their daily activities satisfactorily and independently (Medola, 2020; Iancu, Iancu, 2020). Therefore, knowledge of the characteristics and needs of aging people is fundamental to accomplishment in this process. One way is to offer technologies (products and services) that solve their main problems, to increase their general quality of life and to help them regain some control and live autonomously (Sainz de Salces et al., 2003; Andronico et al., 2014; Iancu, Iancu, 2020). However, many of these designs often are not suitable to their needs (Roupa et al. 2010). According to a research report of UK Office for Product Safety & Standards (2021), a more inclusive design would be beneficial for all consumers (not only for older users); however, manufacturers do not recognize a market for these products and focus on younger consumers. According to the Brazilian National Confederation of Store Managers (CNDL), published in 2021, 60% consider it difficult to find a specific product [that meets their needs].

Also according to the research report of UK Office for Product Safety & Standards (2021), “changes to ability vary greatly among older people, though commonly include changes to strength and dexterity, mobility, sensory function, and cognition and memory”. Then, the phenomenon of aging is directly accompanied by a decrease in the organism's functional capacity (Wagner et al., 2019), especially motor capacity. According to data from IBGE – National Health Survey (PNS) –, in 2019, it was estimated that there are 17 million people (over 2 years old) in Brazil with some disability related to at least one of their functions. Of these, 49.4% were people aged over 60 years old and 32.4% were people aged between 40 and 59 years old. Looking specifically at People with Motor Disabilities (PWMD), approximately 8 million people over the age of 2 were considered to have physical disabilities in the lower limbs. Almost 5 million people in this population were aged 60 or over (almost 15% of this portion of the population).

Around the world, especially in Europe, this phenomenon of aging is reality and constitutes a portion of the market named silver economy. According to the European Commission (2018) “(...) silver economy encompasses a unique cross-section of
economic activities related to production, consumption, and trade of goods and services relevant for older people, both public and private, and including direct and indirect effects”. In other words, it is all economic activities, including products and services, for elderly people. For this definition, “older people” are considered to be all those persons aged 50 years and over.

Parise et al. (2023), in a recent study, examined products for elderly people, but discarded those that equated the needs of aged people with those of people with disabilities. As more than 50% of PWDM are from people over the age of 50 – Old People with Motor Disabilities (OPWMD)—, the objective of this study is to search for technologies (patents and utility models) for this population that have been registered in Brazil, due to the growing population aging process, but also in Europe and USA, where concerns about aging are already real.

METODOLOGY

This study started from defining the objective of the search and defining the keywords and platforms to be used in the search. Then, the search was carried out, observing the criteria adopted. Next, the data was processed and, finally, the results obtained were analyzed as well as the conclusions of the study. The flow of the method used in the study is illustrated in Figure 1.

Figure 1 – Research method flow diagram for this study.

The objective of this study is to verify the technological scenario of products intended for elderly people with motor disabilities in Brazil, Europe and USA. The patent search will be conducted on the platforms of the National Institute of Industrial Property (INPI), Espacenet and United States Patent and Trademark Office (USPTO), electronic platforms of the patent offices in Brazil, Europe and USA, respectively.
On the INPI search, the keywords “envelhecimento” (aging) OR “idos*” (elderly) OR “velh*” (old person/people) will be used – to reproduce the finding of Parise et al. (2023) –, and also the keywords “terceira idade” (third age) OR “silver economy”. Due to the platform’s search engine, the inclusion and exclusion processes will be applied manually by reading each title and abstract of results. As inclusion criteria, patents and utility models dedicated to solving the needs of elderly people with motor disability in the lower limbs, such as: balance (risk of falling); locomotion; movement on, to or out of furniture (bedroom, living room etc. such as chairs, bed and similar), vehicles (get in or get out), home/office/public utilities (in bathrooms, kitchens or laundry); and dress up. As exclusion criteria, patents and utility models dedicated to solving the needs of elderly people with others disabilities (in the upper limbs; mental, cognitive, intellectual or neurological disabilities; visual/blind; hearing/deaf), and other purposes, such as: sexual dysfunctions; diverse treatments and ant-aging treatments (skin, cell or body parts); methods or procedures; formulas; cosmetics and drugs; chemicals and adhesives; materials and machines (steel and alloys; engines and motors); circuits, signals and communication; and food. Then, the skills will be used to compose the Boolean logic for the search on Espacenet.

The search will be conducted using keywords in the title and abstract in an advanced manner. No criteria will be defined regarding the patent language or the patent period. The search was carried out on December 11, 2023. The data obtained was processed in an electronic spreadsheet.

On Espacenet, the keywords "old person" OR "old people" OR "aging" will be used together with the keywords (Boolean AND) "impairment" OR "motor disabled people" OR "motor disability" OR "disability" to find results dedicated to solving the needs of elderly people with motor disability in the lower limbs. Applying the skills learnt on the INPI search, the keywords (Boolean NOT) "cognitive" OR "memory" OR "method*" OR "wheelchair" OR "neurological" OR "intellectual" OR "visual" OR "blind" OR "deaf" OR "treatment" OR "dementia" OR "brain" OR "medicament" OR "pharmacological" OR "pharmaco" OR "formula" OR "formulation" OR "infusion" OR "skin" OR "cell" OR "alloy" OR "steel" OR "engine" OR "circuit" OR "composite" OR "cosmetics" OR "food" OR "extract" OR "chemical" OR "acid" OR "gas" OR "material" OR "composition" OR "signal" OR "communicator" OR "communication" were included in the search. The term "wheelchair" was introduced as a keyword for the
exclusion criteria (Boolean NOT) since this is the assistive device used by 90% of people with mobility limitations (Woude et al., 2001).

The search will be conducted using keywords in the title and abstract in an advanced manner. No criteria will be defined regarding the patent language or the patent period. The search was carried out on December 13, 2023. The data obtained was processed in an electronic spreadsheet. After carry out the search, each title and abstract of the results were read applying the same inclusion and exclusion criteria described in the INPI search.

On USPTO search, the same procedure applied in the search on Espacenet was used: the search keywords and the Boolean logic (AND and NOT keywords). The search will be conducted using keywords in an advanced manner, however in all text fields (no option to search only in the title and the abstract was found). No criteria will be defined regarding the patent language or the patent period. The search was carried out on December 13, 2023. The data obtained was processed in an electronic spreadsheet. After carrying out the search, each title and abstract of the results were read applying the same inclusion and exclusion criteria described in the INPI search.

The data collected for this study will be: the applicant and inventor, the priority country, the application and publication dates, and the IPC (International Patent Classification) codes. Publications with a purpose different from that outlined in the search objective will be counted, but classified as “miscellaneous”. Identical publications with different registration numbers (in different offices, for example: PCT - Patent Cooperation Treaty) or patents and utility models with the same contents – if passed in inclusion and exclusion criteria –, the first publication will be counted, and the other, classified as “miscellaneous”.

The data obtained was processed in an electronic spreadsheet. Once all patents were collected, the next step was processing the data on the results obtained.

RESULTS

On INPI, 268 registers were found, 267 with the keywords “envelhecimento” OR “idos*” OR “velh*”, 1 with the keyword “terceira idade” and no results with the keyword “silver economy”. This value is double that found by Parise et al. (2023) – 130 registers were found with the 3 first keywords –, however, they have limited the period between 2017 and 2022, different from this study which has no established limit.
Comparing the results in the same period, 59 registers were found, disagreeing with the authors. After processing, only 17 results met the inclusion and exclusion criteria. Then, about 94% of the results were considered miscellaneous, including the unique result obtained with the keyword “*terceira idade*”.

On Espacenet, 53 registers were found, 32 results met the inclusion and exclusion criteria. About 38% of the results were considered miscellaneous. This value shows that the Boolean logic composed was an efficient filter. The same cannot be said for the USPTO search, where only about 37% of the results (6 of 16 registers) met the inclusion and exclusion criteria after processing. It should be noted that the USPTO search was conducted in all text fields; a different result would be found if there was an option to search only in the title and the abstract.

Comparing these results, Brazil has more registers (17 results) than the USA (6 results) and half the registers of an entire continent (33 results), despite these two locations having an aging population and where concerns about aging are already real. No results were duplicates, meaning no PCT was required and the databases are not connected. Therefore, the search found 55 results.

**Figure 2** – Distribution of registers in relation to priority countries.

The quantity of registers in relation to priority countries are shown in Figure 2. China was the country where there were the most registers, 31. Next, there were 17 registers in Brazil and 6 registers in USA. Then, Japan and Korea (South) appear with 1 register each. No Europeans were listed, although the search was carried out on Espacenet (electronic platform of the patent office in Europe). It was also noted that there was a
unique register in Japan, another country where there are concerns about population aging.

In addition to the total of registers, the number of utility models – UM – (red columns) and inventions – INV– (blue columns) are presented in Figure 2 (26 UM and 29 INV). Of the 30 Chinese registers, 18 were UM, representing about 60% of total. Then, only 12 results were INV dedicated to meeting the needs of elderly people with motor disability in the lower limbs; most of the technology developed can be considered adaptations of ongoing products. Brazilian registers were almost 50% each (9 INV and 8 UM), only 3 inventions less than China and a greater number than USA, in which all the 6 registers were INV.

**Figure 3** – Distribution of applications per year.

![Figure 3](image)

Source: Authors (2024), with INPI, Espacenet and USPTO data.

The distribution of applications over time is shown in Figure 3. The first register found was a patent filed in 1960 in USA. From 1961 to 1987 no registers were found. Then, the applications alternated from unique to none, year after year, until 2002, when 2 registers were filed (1 INV and 1 UM). 6 registers – 2 INV (1960 and 1997) and 4 UM (1988, 1989, 1992 and 1995) – are more than 25 years and expired for lifetime. About 86% of registers were filed in the last 20 years. 2018 concentrates the top number of applications (6 registers, 3 INV and 3 UM), 2008, the top number of UM (5 applications), and 2016 and 2020, the top number of INV (4 applications in each year). No applications were found in 2023 until the data of this study.
The distribution of publications over time is shown in Figure 4. The first register found was the patent filed in 1960, published in 1962 in USA. Again, there was a hiatus from 1963 to 1988 when no registers were found. The same behavior as in Figure 4 can be noted in Figure 6: publications alternated from unique to none, year after year, but until 2005, when 2 registers were published (1 INV and 1 UM). After 2011, registers have been published every year, representing about 76% of total. 2018 concentrates the top number of publications (7 registers), followed by 2021 (6 registers) and 2017 (4 registers). No publications were found in 2023 until the data of this study.

**Figure 4** – Distribution of publications per year.

The average evaluation time, considering all registers, was around 1 year and 4 months; the fastest evaluation was about 3 months (CN114145670A) and, the longest was about 3 years and 5 months (MU 8800335-3, MU 8800337-0, MU 8800352-3, MU 8800405-8 and MU 8800467-8) – it was noted that all these registers were filed and published in the same days. A particular look in the Brazilian data, the INPI average evaluation time was around 2 years and 3 months; the fastest evaluation was about 1 year and 2 months (BR 10 2013 020691 1) and, the longest was about 3 years and 5 months (again MU 8800335-3, MU 8800337-0, MU 8800352-3, MU 8800405-8 and MU 8800467-8). Comparing the data, the fastest evaluation in Brazil was close to the longest Espacenet results (1 year and 7 months) and the USPTO average evaluation time (1 year and 6 months). The INPI average evaluation time is close to the longest USPTO results (1 year and 11 months).

The registers were classified in 79 different IPC codes. USPTO results were not counted as only CPC codes (Customs Procedure Codes) was found. Codes A41F 1/00
(Fastening devices specially adapted for garments), A47K17/02 (Body supports, other than seats, for closets, e.g. handles, back-rests, foot-rests; Accessories for closets, e.g. reading tables), A61G5/10 (Parts, details or accessories – Chairs or personal conveyances specially adapted for patients or disabled persons), A61G7/05 (Parts, details or accessories of beds (devices for prevention against falling out – Beds specially adapted for nursing; Devices for lifting patients or disabled persons), A61H1/00 (Apparatus for passive exercising; Vibrating apparatus; Chiropractic devices, e.g. body impacting devices, external devices for briefly extending or aligning unbroken bones), A61H1/02 (Stretching or bending apparatus for exercising – Apparatus for passive exercising) and A63B23/04 (for lower limbs – Exercising apparatus specially adapted for particular parts of the body) occurred 3 times each. Codes A61H3/04 (Wheeled walking aids for patients or disabled persons – Appliances for aiding patients or disabled persons to walk about), A47K7/04 (Washing or cleaning devices, hand or mechanically operated – Body washing or cleaning implements), A61G5/06 (with obstacle-mounting facilities – Chairs or personal conveyances specially adapted for patients or disabled persons), A61G7/015 (divided into different adjustable sections – Beds specially adapted for nursing; Devices for lifting patients or disabled persons), A61G7/057 (Arrangements for preventing bed-sores or for supporting patients with burns), A61G7/075 (for the limbs – Parts, details or accessories of beds), A61G7/10 (Devices for lifting patients or disabled persons), A61G7/14 (facilitating both lifting and lateral movement of the patient or disabled person), A61H7/00 (Devices for suction-kneading massage; Devices for massaging the skin by rubbing or brushing not otherwise provided for), A63B22/06 (with rotating cycling movement – Exercising apparatus specially adapted for conditioning the cardio-vascular system, for training agility or co-ordination of movements), B60N 2/14 (rotatable, e.g. to permit easy access – Seats specially adapted for vehicles; Arrangement or mounting of seats in vehicles) and B61D31/00 (Sleeping accommodation) occurred 2 times each. Others 60 codes occurred once. The data are shown in Figure 5. The classification A61 (Medical or veterinary science; hygiene) concentrated 26 of the 79 codes and the classification A47 (Furniture; Domestic articles or appliances; Coffee mills; Spice mills; Suction cleaners in general) occurred 21 times, representing (these two classification) around 60% of codes.

Considering all the results, it was identified 99 different inventors, each listed only once, except Vanda Maria de Oliveira Calgaro (5 registers), Cheng Bingshan, Guan Xuchuan, Liu Dayong and Wang Rui (2 registers) and Lu Dehua (1 register). The
data are shown in Figure 6. The major of applicants were individuals (38 registers). Other 18 applicants were companies (10 registers), universities (6 registers), hospitals (1 register) and middle school (1 register), each listed only once, except Shandong Increate Machinery Co LTD (2 registers). The results are shown in Figure 7.

**Figure 5** – IPC, codes and quantity.

![IPC codes and quantity](image)

Source: Authors (2024), with INPI and Espacenet data.

**Figure 6**– Applicants

![Applicants](image)

Source: Authors (2024), with INPI, Espacenet and USPTO data.
Figure 7 – Applicants and number of registers.

Source: Authors (2024), with INPI, Espacenet and USPTO data.

CONCLUSIONS

More than a cold analysis of the number of old persons for many social issues such as social security, the public health system and the economy, this study aimed to verify the technological scenario of products intended for elderly people with motor disabilities in Brazil, Europe and USA. And not just for consumer goods or for preventing aging, but products to solve these people's daily problems, enabling their autonomy, satisfactorily and independently, without the care of others. The inclusion and exclusion criteria were defined to better refine the results, filtering around 84% of the registers. The results show an improvement in the number of registers (INV and UM) in the last decade, corresponding to about 62% of the total found in these three locations. This number was expected due to the growing population aging year after year and the concerns about aging that are already real for the governments of many countries. However, it can be considered little if we look at the size of the population and its challenges; only in Brazil there were 5 million OPWMD.

The different values found by Parise et al. (2023) were not understood. A new search was carried out with each keyword individually, but the sum of the results did not match those found by the authors.

The null result with the keyword “silver economy” shows that there is little knowledge on this topic in Brazil.

The first register found was the patent filed in 1960 and published in 1962 in USA. The reason for the time gap between this first application and the next one found
(in 1988) was not understood. As could be seen in Figure 7, these two registers occurred in different countries (USA and China, respectively), with no apparent relationship. Among the results, no Europeans were listed, although the search was carried out on Espacenet (the electronic platform of the Europe patent office). This was surprising as a large proportion of Europe's population is aged 60 or over. The results may reveal that the characteristics of the European population do not fit in the research: elderly people with motor disabilities. Although Europe has experienced an aging population, this phenomenon occurred during the 20th century. According the World Health Organization (WHO), the oldest population in France, for example, doubled after 115 years; China is expected to double this in 27 years (WHO, 2005). Therefore, the aging process in both countries can result in different characteristics in their populations, such as elderly people with motor disabilities in the Eastern nation in a more prominent way.

China and Brazil (two developing nations whose largest portion of the population is still young, but in an accelerated aging process) were the countries with the largest number of registers. The last 12 registers were applications from these countries. Only Brazil – where it was estimated that 49.4% of the population with some disability related to at least one of their functions were people aged over 60 years old – accounted for around 30% of the registers found. In USA, another country where there are concerns about population aging, only 6 patents were found.

The number of UM and INV – 26 and 29, respecting – shows that about 47% of the technology developed can be considered modification (adaptation) of ongoing products. They can be design improvements or new technical applications of known solutions adapted to solve needs. Only 29 results were INV (new solutions) dedicated to meeting the needs of elderly people with motor disability in the lower limbs. This confirms the market’s focus on younger consumers, offering few specific products to OPWMD or even more inclusive design. The efficiency of these inventions and modifications to solve the problems in which they were created is not objective of this study, being a future study.

The distribution across 79 different IPC codes suggests a diversity of solutions and applications for the products. 60% of solutions were classified as medical/hygiene or furniture/domestic articles codes (A61 and A47, respectively). This could be expected due to nature of the OPWMD main needs, including medical devices used in home care such as chairs or chairs parts, beds or beds parts, apparatus for exercise, and wheeled walking aids for disabled persons. This last classification was found even
excluding wheelchairs as a keyword, demonstrating that wheeled devices are solutions related to motor dysfunctions.

The quantity of identified inventors, each listed only once, demonstrates that there was no group dedicated to the study of OPWMD and their main needs. The noted exception – Vanda Maria de Oliveira Calgaro, with 5 registers – filed different variations of the same product. Companies filed more applications than universities (10 and 6 registers, respectively). This was above the expected, as universities invest more in research and scientific development around the world. The fact that the major of applicants are individuals (38 registers) may suggest a close relationship with OPWMD experienced by these inventors, such as Brandão et al. (2019) verified to persons who wanted to live to an advanced age. Thus, people who experienced a close relationship with old persons, observing their daily needs and the products available, could propose solutions in an attempt to meet these needs and improve their quality of life.

As the number of elderly people is expected to increase around the world and their considerable share in the population of people with mobility disabilities, it can be concluded that there is a market gap for products aimed at this group.

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