

The importance of kitchen furniture ergonomics for people with disabilities

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Abstract: *The importance of kitchen furniture ergonomics for people with disabilities.* The goal of this paper is to evaluate the kitchen equipment for people with disabilities from the point of view of furniture ergonomics and their adaptation to the needs of this social group. Research has shown that the majority of respondents are not satisfied with the equipment of their kitchen and, having such an opportunity, would make changes to it. At the same time, the responses showed little knowledge of people with disabilities about the available design solutions for furniture available on the market.

Keywords: kitchen furniture, ergonomics, disabled, survey

INTRODUCTION

According to World Health Organization data, about 15% of the global population live with some form of disability, which means that over one billion people all over the world suffer from temporary or permanent limitation of the body's efficiency (WHO, 2020). Moreover, due to the demographic trends and increasing chronic health conditions the number of people with some form of disability rises. Many of these people require appropriate equipment for everyday life (Joshi and Sumant, 2019).

The concept of disability is very broad. There are many attempts to explain the concept of disability, developed by individual countries and international bodies. For example, according to Centers for Disease Control and Prevention (CDC) disability is any condition of the body or mind that causes more difficult for the person with the condition to do certain activities and interact with the world around them (CDC, 2020). These difficulties may be related to person's vision, movement, thinking, remembering, learning, communicating, hearing, mental health or social relationships. Disability may be related to:

- a). conditions that are present at birth and may affect functions in later life (in cognition, such as: memory, learning and understanding problems; in mobility, vision, hearing, behaviour and other areas) causes by:
 - disorders in single genes,
 - disorders of chromosomes,
 - mother's exposure during pregnancy to infection or harmful substances (alcohol, cigarettes).
- b). developmental conditions apparent during childhood (such as autism spectrum disorder or attention-deficit/hyperactivity disorder or ADHD);
- c). injury (for example traumatic brain or spinal cord injury);
- d). long-standing condition (such as diabetes),
- e). conditions which are progressive (such as muscular dystrophy), static (limb loss) or intermittent (such as some forms of multiple sclerosis) (WHO, 2021).

An example of international approach to the problem is the definition of disability proposed by WHO. According to it disability has three dimensions:

1. impairment in a person's body structure or function, or mental functioning (e.g., loss of memory, limb loss);
2. activity limitation – this disability group contains such limitations in functioning as difficulties in seeing, hearing, walking;

3. participation restrictions in daily activities (like working, engaging in social and recreational activities, obtaining health care and preventive services) (CDC, 2020).

There is also a definition of disability in national law (Obwieszczenie Marszałka Sejmu..., 2021). Disability is defined there as a permanent or temporary inability to fulfill social roles due to permanent or long-term impairment of the body's efficiency, in particular resulting in inability to work. Other explanation of the concept of disability is provided by Karta Praw Osób Niepełnosprawnych, a document passed by Polish Sejm (Uchwała Sejmu..., 1997). According this document disabled persons are those, whose physical or mental efficiency permanently or periodically hinders, limits or prevents everyday life, study, work and social roles.

In Poland, physical dysfunctions are the most common cause of disability, just like cardiovascular diseases. It is estimated that people with physical disabilities make up to half of the population of people with disabilities. Almost 43% of this number are people, that had orthopaedic injuries and rheumatoid diseases (Ostrowska and Szczepankowska, 1998). Locomotor dysfunctions most often are the result of disease or injuries, in a lesser extent are caused by congenital defects (Kurkus-Rozowska, 2002). This means that people with disabilities due to dysfunction of the locomotor system are people who have limited efficiency of the upper or lower limbs or the spine, caused by lesions, injuries of the central nervous system or changes in the skeletal, muscular or peripheral nervous system.

Therefore, the physically disabled are a very diverse population. There is a wide spectrum of motor disabilities degree – from mild cases to severer where such a person has to be helped by other people.

Regardless of the cause and degree of the motor organ dysfunction, people with motor disabilities can be divided into the following groups:

- a). people with dysfunction of the upper limbs
- b). people with lower limb dysfunction who:
 - can move around in a wheelchair;
 - moving without the aid of a wheelchair, but using orthopaedic equipment permanently or only temporarily
- c). people with dysfunction of the spine and hip belt (Kurkus-Rozowska, 2002).

Therefore, systematics of the motor disability group is relatively difficult to establish, especially when the disability results from the interdependence of individual organs of the body and the functions they perform and which may be impaired (Kirenko, 1998). According to statistical data, the number of people with motor disability caused by the limb amputation increases. The cause of amputation may be sudden trauma, neoplastic changes in the limbs and diseases of the peripheral circulatory system (Moskalewicz, 1998).

Regardless of the cause and degree of motor organ disability, it can also be defined taking into account the barriers in the environment of disabled person. Therefore, motor organ disability can also be defined on the basis of the presence of technical and architectural limitations in the environment, lack of transport facilities, limitations in access to information and limitations on the labour market (Migas, 2007a,b). For this reason, in order to improve the quality of life and enable persons with disability to lead an active life and fulfil social roles, it is important to remove these limitations (Todys, 2020). Therefore, it is important to organize the space that would ensure normal participation in life for disabled people. Ergonomic and economic use of space, however, is determined by the type of disability and the group of diseases. For example, people in wheelchairs differ in reach of the upper limbs. These factors have a significant impact on the design of the space that will be used by a disabled person (Nowak *et al.*, 2008, Koboshima and McIntosh, 2021). The basic parameters that should be considered when determining the space for a wheelchair user are:

- a). the manoeuvring surface, i.e., the range of movements of the wheelchair in the forward, backward and sideways and around directions;
- b). dimensions of the wheelchair, including in particular the width and height of the seat;
- c). sight level and range;

- d). the person's in a wheelchair hands range of motion in the vertical, horizontal and sideways directions (Gajda, 2007).

Designing principles

The idea of a society that includes all citizens in the life, ensuring equality and the opportunity to participate in social life, led to the concept of universal design. This type of design is based on several principles and takes into account the available and useful space and its minimum required dimensions. According to the aforementioned design, for wheelchair users the minimum dimension needed for mobility is 80cm (Ministerstwo Rozwoju i Technologii, 2020). The wheelchairs offered on the market vary greatly - the offer depend mainly on the type of disability, the dimensions of the width of the wheelchairs however do not exceed the above-mentioned minimum mobility space for a wheelchair (usually 50-67cm for active wheelchairs, 60-70cm for electric wheelchairs and up to 75cm for ordinary wheelchairs). The concept of universal design determines also the reach of an adult's upper limb in a wheelchair. The maximum dimensions are as follows:

- a). side reach of the hands – 137cm;
- b). front reach of the hands – 122cm;
- c). comfortable range - from 40 to 110 cm.

These dimensions are shown in Figure 1.

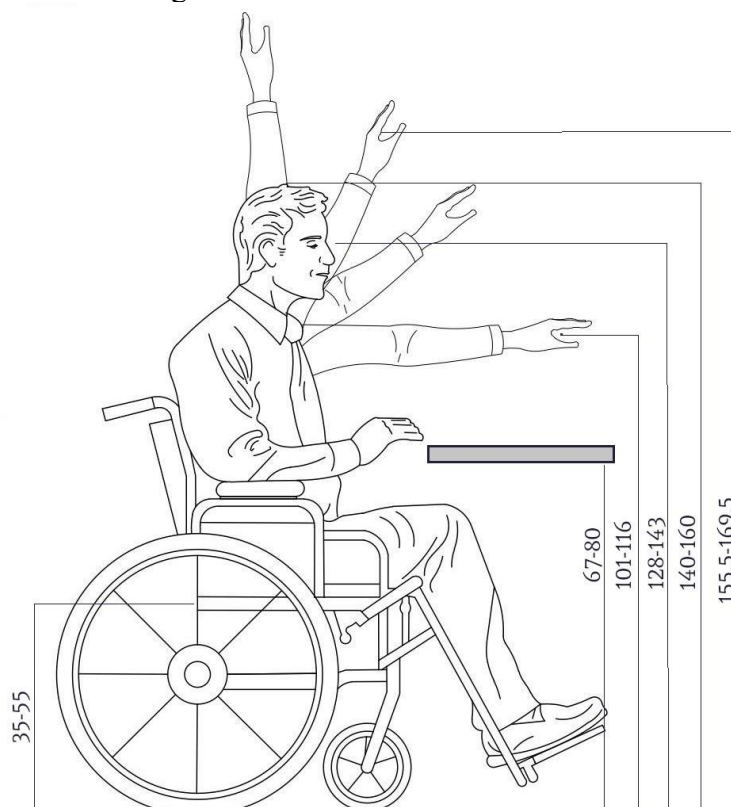


Fig. 1. Dimensions and range of hands for a sitting man on wheelchair – in centimetres
(Source: Authors' own study based on Sydor, 2002 and <https://www.firstinarchitecture.co.uk/>)

Determining the range of hands of a person in a wheelchair, the following dimensions are considered:

- a). upper (the maximum height at which the items can be placed);
- b). lower (the lowest height that people in a wheelchair can reach);
- c). front and side reach of hands (important when working at a desk or sitting at a table).

Another important element to consider when designing space for a wheelchair user is the manoeuvring space. Its minimum dimensions are defined as:

- a). the area for making a full turn by 90 degrees, which is 150x150 cm;

- b). wheelchair wheel diameter (making a full wheel rotation), which is 170x170 cm;
- c). the area needed to make a turn by 90 degrees while wheelchair driving, which is 150x180 cm;
- d). the area needed to make a 180-degree rotation relative to the stationary point of the rotation axis, which is 200x200cm.

The space design elements mentioned above should be considered when designing furniture for a wheelchair users, especially kitchen furniture that will be used by a disabled persons on a daily basis (Bonenberg *et al.*, 2019). For many people, the kitchen is the most important room in the house. It should be noted, that kitchen furniture should be designed according to the principles of ergonomics. Aesthetics of furniture designed for wheelchair users are less important than functionality and safety. This makes the design of kitchen spaces and furniture an important issue, as it should provide functionality and allow to prepare meals in a safe and comfortable way possible (Crytzer *et al.*, 2017).

To design properly the space for a disabled person using a wheelchair, it is necessary to know the optimal and maximum ranges of their arms in a sitting position. The further distance and keeping the arms straight for a long time causes rapid fatigue. Therefore, the arrangement of all devices and places of frequent access should ensure access to them in the shortest possible way. Therefore, it is important to define the so-called comfortable operating zone - the normal range, i.e. a situation in which the arm does not fully straighten- For this reason, kitchens require an individual approach to design, require specific equipment intended for specific people. For disabled persons in a wheelchair an access to kitchen worktops, reaching into cabinets, maintaining ergonomics and working in the comfortable condition is a particularly important issue. Modern household appliances already have solutions that facilitate the free use of them by people in a wheelchair. This applies, among others, to technological solutions for example, in opening the oven door or guides used to automatically slide the tray out of the oven. In the structure of the furniture itself, replaceable additional shelves and table tops extending from under the worktop can be mentioned. The edges of the cabinets should be set back by 15 cm due to the wheelchair construction (Gałązka *et al.*, 2011).

The basis of a well-designed kitchen for a wheelchair user is the correct arrangement of workplaces and kitchen appliances. There are several issues to consider during this. First of all, it should be remembered that the optimal height of the working plane should be between 80 and 85 cm from the floor level, the depth of the worktop should be 55-60 cm, the optimal dimension of the working plane should be approx. 300 cm.

Accessibility of kitchen cabinets for people in a wheelchair is also important. The height at which the cabinets and shelves are hung is closely related to the reach of the arms of a person sitting in a wheelchair. This range is assumed to be 50 to 135 cm. Reaching higher or lower for a disabled person is not only inconvenient, but may result in a fall. Therefore, it is assumed that kitchen cabinets should ideally be at a height of 70 to 100 cm from the floor. In the case of kitchen cabinets, the way of opening them is also important - to ensure the possibility of wheelchair manoeuvring and easy access to food products, the doors of the cabinets should open in the range of 110-280 degrees (Nowak *et al.*, 2008). When a disabled person lives with a non-disabled person, kitchen cabinets can be mounted higher, so that less frequently used items can be placed higher, but the depth of the cabinets should be limited to 32 cm. There are a number of kitchen cabinets on the market with technical solutions that facilitate their use by disabled people, including those that allow them to lower shelves to the eye level of a wheelchair. Classic kitchen cabinets should not be higher than 87 cm and their depth should not exceed 50 cm (Sydor, 2002).

In addition to furniture in the kitchen, kitchen appliances, such as a refrigerator, oven or sink, are also important. In this case, their arrangement is also important, which should be based on the principle: "storage - washing - preparation - cooking". It is important that the stove, sink, oven and worktop are on the same level as it makes it easier to move the dishes. In the case of a table and sink, it is important to have a free working area, which should not be smaller than 40 cm on each side. Providing convenient access to products is also important in the case of a refrigerator. It would be good if the refrigerator was placed on a pedestal that would provide an access to the lower shelves

for disabled person. Ideally, the lowest shelf in the refrigerator should be 30 cm above the floor, while the highest - a maximum of 140 cm from the floor.

Another element of the kitchen equipment is an oven. Its maximum distance from the floor level should not exceed 60 cm.

Height restrictions from the floor also apply to the design of the dishwasher. It is recommended that it should be at a height of not less than 40 cm from the floor level, which will facilitate handling by a wheelchair user.

A kitchen for a wheelchair user should be functional and safe. When designing it, apart from the dimensions and location of the furniture, the location of contacts and electrical switches should also be considered. For the safety and convenience of the user, they should be 10 cm above the edge of the table top or on special electrical panels.

MATERIALS AND METHODS

The objective of this paper was to examine the needs of people with disability in the field of kitchen furniture. For this purpose, in the first stage, a questionnaire consisting of 21 questions was developed and an appropriate research group was selected. The data were collected through a two-part questionnaire. Part A consisted of questions focused on socio-economic identification of the disabled persons. Part B consisted of questions aimed at finding out how disabled people assess their kitchen environment and its equipment.

A 100 people with motor disabilities, using a wheelchair, participated in the research carried out in Wrocław, Katowice, Warsaw and the surrounding area. More than a half of the respondents were women (exactly 58%). The most numerous age group of people with disabilities were over 66 years of age. This group included 36% of all respondents, among them 21 were women. The number of respondents in the age groups 41-55 years old and 56-65 years old was similar (respectively 23% and 25%). The smallest group of respondents were people aged 18-25 years old (5% of all respondents). It can be noted that the majority of respondents were over 41 years old (84%).

Due to the level of education, the respondents could be classified as having primary (26% of all respondents), secondary (29%) vocational (33%) and higher education (12%).

The surveyed group had a different professional status: the majority were retirees and pensioners (55%), 27% of the respondents described themselves as professionally employed, and 10% of the respondents described themselves as learning. The respondents who could not be classified into any of the mentioned above groups accounted for 8%.

Most of the respondents came from larger cities (51-100 thousand inhabitants) - 35%; 30% from towns up to 50 thousand inhabitants; 20% of the respondents lived in the countryside, and 15% came from cities with over 100,000 residents. Only slightly more than a quarter of the respondents indicated in the survey that they have used a wheelchair since birth.

RESULTS

The conducted survey allowed to obtain answers to the questions about the independence of the disabled. The answers to the question about independence of people with disabilities are presented in Figure 2.

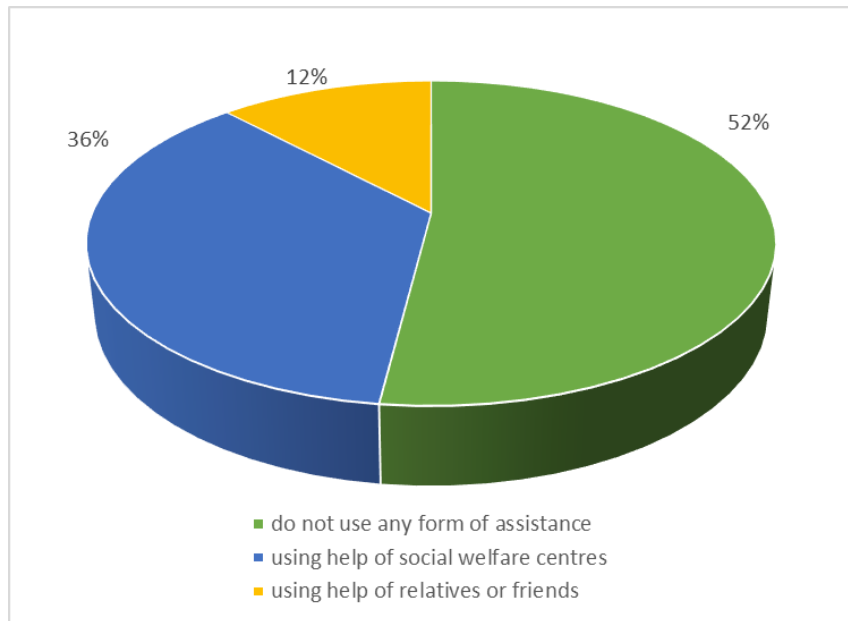


Fig. 2. Answers to the question about independence of people with disabilities

Most of the disabled persons do not use any form of assistance, the second largest group are using the help of social welfare centres, and only 12% use the help of relatives or friends. Then the respondents were asked about safety in their kitchen. The responses are illustrated in Figure 3.

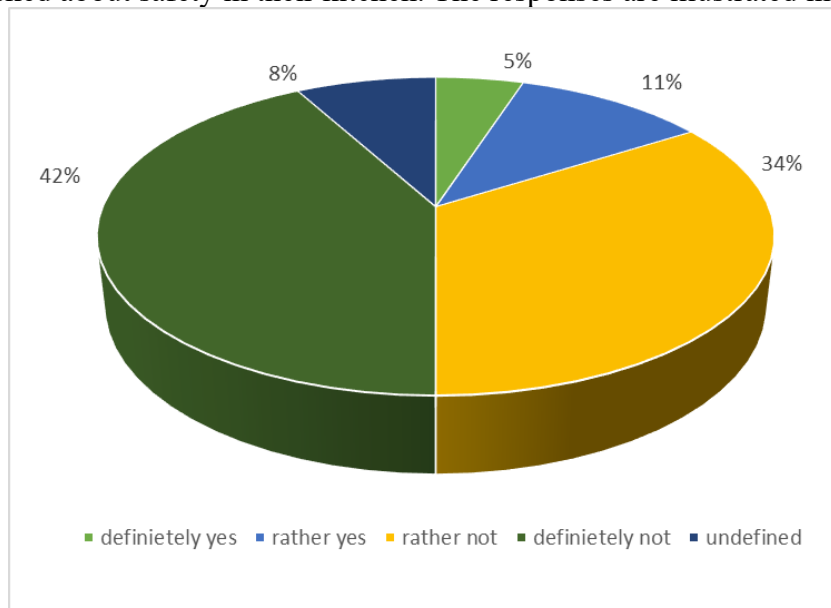


Fig. 3. Answers to the question of safety in the kitchen

As the Figure 3 analysis shows, most of the respondents do not feel safe in their kitchen (76%), only 16% of the respondents gave a definitely positive answer to this question.

The next question in the survey was about independence in food preparation. The results showed that despite the disability, most of the respondents prepare their meals on their own (Figure 4).

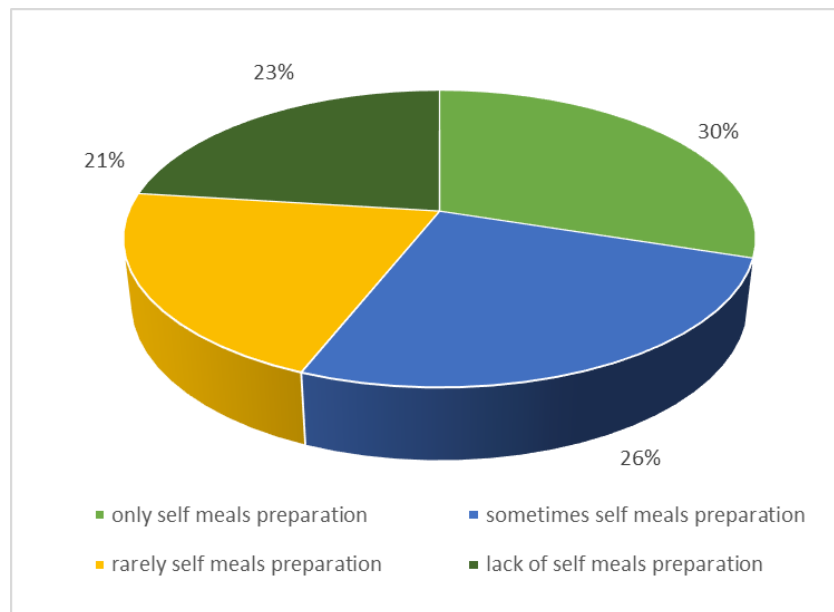


Fig. 4. Answers to the question of independence of disabled in meals preparing

Asked about the reasons for not preparing meals for themselves (the lack of independence in preparing meals), respondents replied that the main obstacle was not their disability, but the kitchen maladaptation. The vast majority of respondents (61%) answered that if the kitchen was adapted to their needs, they could use it independently. The answers obtained to this question are presented in Figure 5.

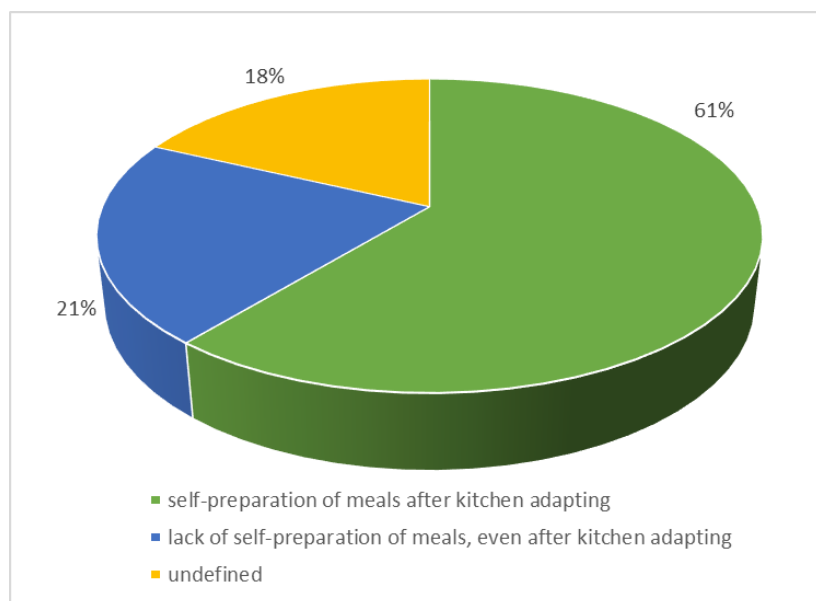


Fig. 5. Answers to the question about the importance of a well-equipped and adapted kitchen for the independence of people with disabilities

Figure 5 analysis shows that well-equipped, adapted to disabled needs kitchen and possibility of independent meal preparation does not matter for 21% of respondents. The reason for such responses may be a significant degree of disability, which makes it impossible to prepare meals on their own.

Subsequent survey questions were aimed at clarifying the assessment of the kitchen in terms of the needs of a disabled person using a wheelchair. As the analysis of Figure 6 shows, the vast majority of respondents believe that they are in possession of unsuitable kitchen.

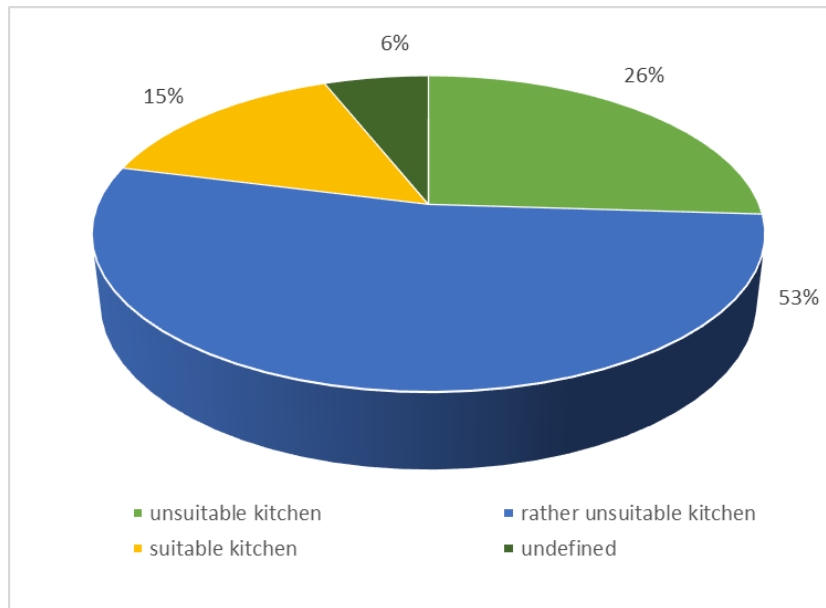


Fig. 6. Answers to the question of assessment of the adaptation of the kitchen

The surveyed disabled persons also identified three most difficult factors in food preparation in their kitchen, especially:

1. the worktop placed to high (29%);
2. unsuitable furniture dimensions (16%);
3. methods of drawers opening (13%).

The list of all difficulties in kitchen equipment indicated by the respondents is presented in Figure 7.

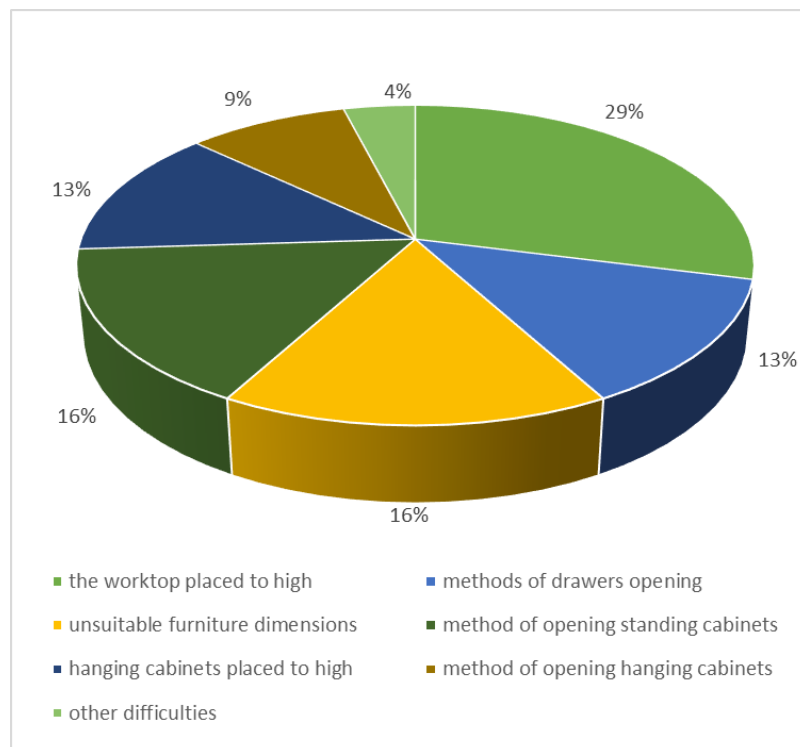


Fig. 7. Answers to the question about main difficulties in kitchen equipment

Taking into account the difficulties in using the kitchen, as many as 89% of respondents intended to change their kitchen equipment. The most frequently mentioned equipment included hanging cabinets (36% of respondents would replace them), a stove (22% of respondents would like to have an electric stove instead of a gas one) and a table (18% of the disabled). Apart from the most frequently mentioned changes, the respondents also indicated:

1. convenient drawers and cabinet doors opening (12%);
2. the oven positioning at the correct height (11%);
3. easy access to the refrigerator (8%).

Despite noticing deficiencies in kitchen equipment, the questionnaire survey showed little knowledge of furniture adapted for the disabled persons. The analysis of Figure 8 shows that a significant group of respondents do not know manufacturers of furniture for the disabled persons or have never looked for such furniture.

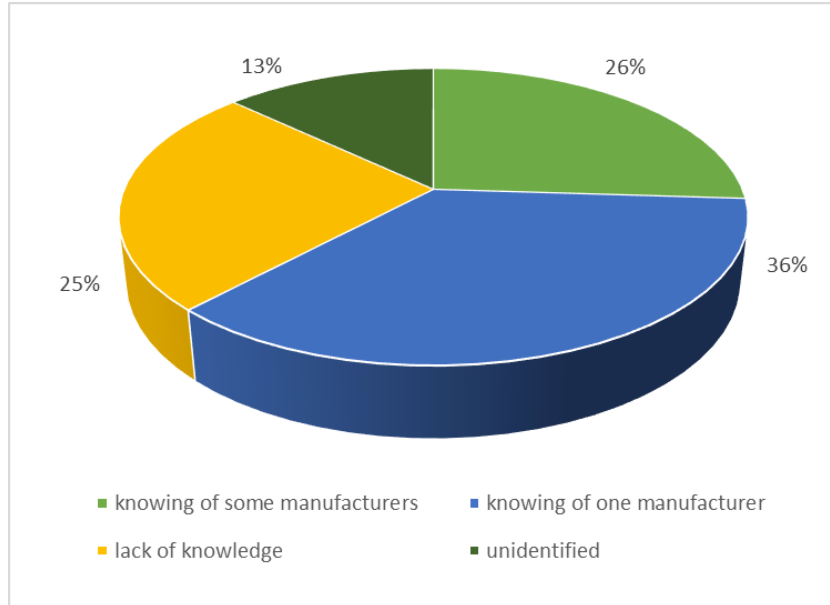


Fig. 8. Answers to the question about knowledge of manufacturers offering kitchen equipment for the disabled

Apart from little knowledge of this market segment, there are a number of factors indicated by the respondents as making it difficult or impossible to arrange the kitchen according to the needs of wheelchair users. They are presented in Figure 9.

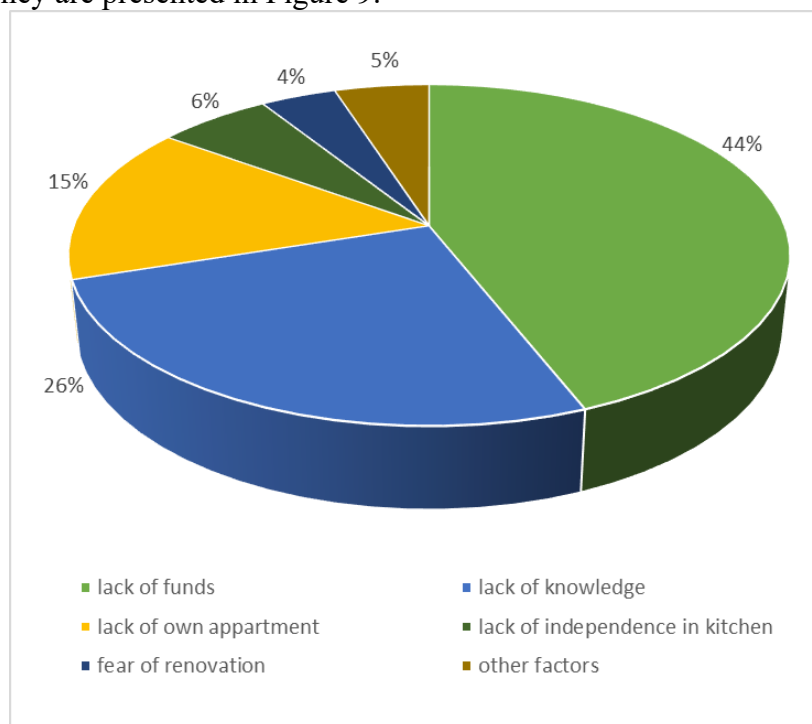


Fig. 9. Answers to the question about factors making difficult or impossible to arrange the kitchen

CONCLUSIONS

The kitchen is a unique place that can be called the heart of the home. Without it, every day modern man functioning seems practically impossible. Due to the kitchen importance, in the design process the key should be to enable safe meals preparation. The premise in the kitchen's designing should be the purpose of the room, especially tailored to the requirements of the person who will use it on a daily basis. It is particularly important in the case of disabled people, because the kitchen design, apart from the appropriate arrangement of appliances, should meet a number of specific furniture design solutions. The results of the survey conducted among people with disabilities showed, first of all, the lack of adaptation of this room design solutions to the persons using a wheelchair and their low level of knowledge about the available solutions in this area. It seems that the reason for the little knowledge of people with disabilities about the solutions available on the market in the field of kitchen equipment may be insufficient information campaign on the part of companies offering this type of furniture. It seems that possible limitations resulting from insufficient financial resources for this type of investments can be effectively combated thanks to favourable legislative changes and government programs.

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Streszczenie: *Znaczenie ergonomii mebli kuchennych przeznaczonych dla osób niepełnosprawnych.* Celem artykułu była ocena wyposażenia kuchni osób niepełnosprawnych z punktu widzenia ergonomii mebli i ich dostosowania do potrzeb tej grupy społecznej. Badania wykazały, że większość ankietowanych nie jest zadowolona z wyposażenia swojej kuchni i mając taką możliwość dokonałaby w niej zmian. Odpowiedzi ankietowanych wykazały jednocześnie niewielką wiedzę osób niepełnosprawnych na temat dostępnych rozwiązań konstrukcyjnych mebli dostępnych na rynku.

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