

HAND DISABILITIES STUDY AS FRAMEWORK FOR FUTURE DISABLED DESIGN - COOKING TO INCREASE SELF-ESTEEM: EVIDENCE FROM HONG KONG

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ABSTRACT

People with hand disabilities are influenced greatly in various daily activities, such as dressing alone and engaging in cooking tasks. Being limited by the use of only one hand may also have an impact on their self-esteem due to the biopsychosocial approach and social exclusion, despite their ability to manage many of their daily tasks independently. Thus, cooking, which could be a solution for them to face the challenge and support their family by themselves, can serve as an alternative platform for proposing design utensils that support them in developing their self-esteem. Research shows that carrying heavy utensils and processing ingredients systematically with one hand would be a significant challenge in Asian cooking. Therefore, an evaluation of the benefits and drawbacks of pot and chopping board designs could be conducted, along with recommendations for improving the design of such tools for the design educational purpose. Since research is still developing, the design criteria for the cooking utensil which aims to smoothen the cooking process with one hand would be conducted to assist target users in building their self-esteem through cooking.

Keywords: Single hand, disability, cooking, family, challenge, Asian

1 INTRODUCTION OF ONE-HAND DISABILITY

According to the HKSAR Rehabilitation Programme, any person, who has skeletal, musculoskeletal or neurological disability impairment, and mainly impaired motor function, causing the restriction of daily activities, would be defined as a physical disabled person [1]. This indicates whether those invalidated persons are long-term or short-term, such as hemiplegia stroke patients and the casualty with fracture, once the mobility and dexterity of their hand would largely affect their daily life would be one-hand disabled. Although Hong Kong's total population of upper limbs disabilities is only 0.9% [2], people in the world who suffered from the single hand disabled challenge are still high and may increase potentially. In 2018, 450 thousand single hand disabilities already faced hand or arm mobility problems in China [3]. Almomani et al. also points out that young people also have a higher risk to have a range of potential risk factors of upper limb disability and pain since they have approached plenty of electrical devices with inadequate gestures over a long period of time [4].

2 MENTAL CHALLENGE OF ONE-HAND DISABILITY

Hong Kong Federation of Handicapped Youth, conducted an interview researching on physical disability, points out that body-disabled people not only have physiological needs, but also mental and social needs, otherwise biopsychosocial approach and social exclusion would be the barrier to one-hand disability [5]. The biopsychosocial approach refers to the model that consists of both disease and illness, which are based on "the disruption of specific body structures or organ systems" (p.582) and "subjective experience or self-attribution" (p.582) with interpersonal respectively [6]. This indicates that there is a correlation between physical capabilities and mental well-being based on ICF [7] and that reduced performance resulting from hand impairment may affect their self-esteem negatively, compared to those who are able-bodied. Feelings of "anxiety" and "loneliness" are sometimes experienced by physical impairment because of challenges in performing certain activities and sharing their emotions with others [5].

In the social aspect, hand impairments may also experience a mental barrier because of different appearances or lower capabilities compared to others. Larocca et al. explain that the reason some disabilities have a low rate of joining physical activities is the reinforcement of physical limitations from environmental factors [8]. Therefore, their motivation and positive attitude toward the community may decrease, leading to a reduction in their participation rate in social activities. In Hong Kong, the employment rate of physical disability among the population of all disabled persons is only 4.4% compared to the attention deficit hyperactivity disorder (ADHD) persons, that has an employment rate of 31.5%, which is nearly 8 times the difference [9]. This reflects that the physically disabled, like one-hand persons, may have a lower connection to the community and the risk of social exclusion to them possibly higher which may impact their mental well-being negatively because mental illness, like anxiety, could relate to lack of ability to perform an activity because of various scale of impairment [10].

3 COOKING IMPACT ON MENTAL WELL-BEING

Cooking, which requires extensive use of both hands, could be considered a highly complex skill for hand disability. Mastering such skills could build up their self-esteem and provide a significant sense of accomplishment for them. Gainforth et al. also support that higher independence and exercise status rates for physical disability could bring out a positive outcome to themselves, as these actions could promote a positive perception and value to themselves [11]. From a social perspective, hand impairment, who responded to cooking household duty, could provide independent support for those they care for, presenting their ability to show love and care. Therefore, adequate performance of meals, particularly dinner, could be important to a hand impairment to demonstrate their value to their love because dinner preparation, in which the chance of family sitting together is higher and is a platform for establishing and maintaining a family relationship, has a richer food preparation in Chinese food culture [12]. Additionally, structured cooking has the potential to bring a positive psychosocial outcome by improving executive functioning through multitasking and has been successfully practised as various sets of mental therapy to allay some mental illnesses [13]. Hand-disabled persons could cultivate positive mental attitudes by engaging in a complete series of cooking activities. Bryant and McKay also conducted research on the usability of the cooking process with occupational therapists and point out that cooking in the kitchen could be occupational therapy since cooking is a creature and social model, which both factors are also practised for disabilities [14].

4 METHODS

Since cooking is an adequate platform for hand disability to build up self-esteem, research on cooking challenges with one hand were conducted. This aims to identify the design preference of cooking utensils for hand impairment. The design preference shall be defined as the improvement and direction for future disabled cooking design, including the cooking problem with one hand and the potential design solution, which would be elaborated in study 4.1 and 4.2 respectively.

4.1 Case study for cooking challenge with one hand

To gain insight on the cooking experience with a single hand, a study was conducted with the participation of two people, both of whom has cooking experience, and are disabled in one hand. Both were male between the age of 40 and 65 and their interviews were conducted through face-to-face and phone. As the number of participants was limited, additional cooking testing in Table 1 would be necessary to prove the finding (Figure 1).

In this study, both participants highlighted that the time consumption was a major issue, as they were only able to apply one hand to process ingredients during the multi-tasking cooking activities. They needed to learn and adapt to overcome mobility and dexterity issues in cooking by using specific tools. One of the participants stated that “If people need to start dinner at 7: 00 pm, normal people may need around 1 hour while I need to start at 4:00 pm”. This indicates that certain daily events, such as cooking, are less efficient for them compared to those without. In fact, suitable tools could enhance the effectiveness of cooking activities. For instance, in Table 1, the result of the slicing test by using a knife with one hand spends 54 seconds, which is more than 3 times the time taken when using a knife to slice with two hands, this shows that time consumption may occur for hand impairment when

facing dexterity and mobility problems. On the other hand, when using scissors, time was largely reduced to 19 seconds. This demonstrates that some skills and tools needed to be learned and adapted to improve efficiency.

Table 1. Physical testing of slicing food

Process	Knife	Scissor
Average time spent with one hand	54 sec	19 sec
Average time spent with both hands	18 sec	6 sec

Strength and mobility were also major issues for both participants during cooking, as pots and pans, are often bulky and heavy, and are difficult to carry with one hand. One of them stated that he could only use a thick rope as a tool to carry the pot carefully. Canning et al also notice that strength and dexterity are major issues for physical disability due to the loss of muscle activity [15]. During the physical testing (Figure 2), the bowl was necessary when adding water to prepare noodles because the pot would be relatively heavy when adding water directly from the tap with the use of one hand to support it. As a result, a smaller bowl would usually be used to replace the pot and repeat the water-transferring process several times which shows that strength and mobility could be limited when they could only use one hand for cooking.



Figure 1. Noodle cooking process



Figure 2. Transferring water for cooking

This study has shown that processing ingredients and carrying cookware requires extra tools and strength to slice food as well as supporting the weight of tools, these were usually the major challenges face for the one-hand disability. To provide an adequate cooking experience for them, it is important to define the future disabled design framework that addresses the challenge faced in designing cook utensils. Further study is needed to identify the specific utensils design challenge that should be overcome to create a more suitable design for one hand impairment.

4.2 Case study for soup cooking with one hand

Soup, which is a portion of comfort food, is an important part of Hong Kong food culture. In this study, soup cooking was considered as a specific case in this research to provide a clear design direction for designing a hand-disabled cooking utensil. In 2018, the frequency of boiling soup in Hong Kong is around 2.5 times each week which is around 900 thousand soups that have been prepared a day in total [16]. Plus, soup cooking process involves transferring and slicing ingredients, which could be challenging for hand impairment users due to the reduction of strength and support. Therefore, both pot and chopping board designs, that could assist them to cook soup independently for dinner, were addressed to develop for them in the following.

4.2.1 Pot carrying for soup cooking

Plenty of existing pots have been designed with two side handles for two-handed carrying and some cover designs of the pot are created without a hole, leading it difficult for people with hand disabilities to support the pot with a single hand. Although some pots could be locked with the cover, this mainly aims at pouring activities with both hands. To address the challenge of carrying heavy cookware process with one hand, the pot cover handle with a locking system has the potential to be developed.

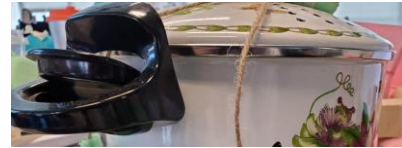


Figure 3. Existing pot study

In the handling study, two types of handles for the pot were designed and tested, one held by the wrist and another by the forearm. During the testing, the handle designed to be held by the forearm has higher strength for carrying a pot due to the muscle in the forearm being stronger than those in the wrist area (Figure 4). This design could also hold the pot more stable when preparing water for soup boiling and shorten the time for transferring water by using a bowl with one hand. On the other hand, the handle designed to be held by the wrist has higher flexibility for one hand to move due to the cluster of carpal bone in the wrist being small and oval in shape, allowing for greater flexibility in various gestures and locations (Figure 5). This design not only allowed the user to depend on the weight of the pot to adjust the orientation of the wrist for transferring purposes but could also hold up the handle at various heights of the location, such as the top or the side. Comparatively, the handle designed for carrying by the wrist is better than by the forearm since it is more flexible to use. Even though the handle designed for carrying by the forearm allows users to carry heavy containers with less strength, its circular tunnel form could only provide one way for the user to carry, which highly reduces its user-friendliness by limiting the flexibility of moving their hand while carrying.



Figure 4. Design for one hand forearm holding

Figure 5. Wrist holding orientation

To improve the process of carrying the pot, two designs were tested, which were an accessory and a redesign of a pot lid. Although the accessory was able to adjust to hold various dimensions of pots, it requires the use of rope that needs to be controlled and surrounded by one hand, which hand impairment could take time to adapt to (Figure 6). Therefore, the redesign of a pot lid with a new handle design was a development of the accessory, inspired by the form of the gripping of common iron handles. It includes features such as a waving form handle for fitting the natural contours of the hand as well as providing comfortable gripping (Figure 7). Waved design of the handle could also distribute the weight and pressure more evenly across the hand, reducing a feeling of tiredness when carrying. Groove is designed from the top of the handle for easy application of forces to enhance the ergonomics of the design.



Figure 6. Accessory testing

Figure 7. Handle testing for pot design

4.2.2 Ingredients processing for soup cooking

Chopping is another challenge for hand-disabled people because it requires both fixing and cutting forces at the same time, which could only be applied one at a time. While many chopping boards have been designed for upper limbs disability, they could be dangerous by involving the use of needles (Figure 8). To find a better solution for the chopping process with one hand, various forms of grooves on the chopping board have been tested by chopping with various types of food (Figures 9 and 10). In the chopping study, short teeth are still needed for the groove to grip different sizes of ingredients but

the length of the sharp area is reduced due to the barrier from the groove. This could help avoid the risk of injury when placing ingredients with a single hand, compared to using a chopping board with needles.



Figure 8. Existing one-hand chopping board [17]



Figure 9. Cutting hard food, apple, testing

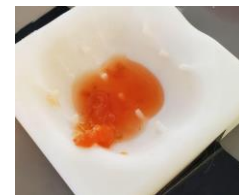


Figure 10. Cutting soft food, tomato, testing

To enable a hand-disabled person to express their support through cooking, further development of the chopping board has been identified, including the flexibility for slicing and transferring ingredients systematically. The half-sphere and cylinder groove design, acting as a barrier, could fix the position of various forms of ingredients, such as apples and carrots, when chopping. Testing has also shown that the orientation of chopping ingredients with the left and right hand are different, so a rotatable chopping board has been designed to suit both left or right hand impairment. In addition, the rotating feature of the working zone could increase the mobility for transferring ingredients. This allows them to directly transfer the food from the chopping board to the bowl nearby and carry it to the pot, reducing the repetition of the cooking process. Considering other ingredients processing methods, such as mixing ingredients, the chopping board design could be suggested by fixing the bowl on the board to prevent it from moving (Figure 12).

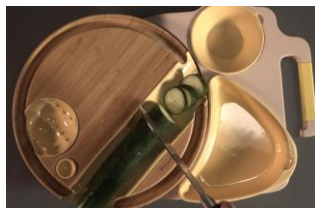


Figure 11. Design for chopping with one hand



Figure 12. Chopping board Prototype for one hand

4.2.3 Discussion

Since both pot and chopping designs for hand-disabled persons have been developed and tested, the design preference for disabled design would be identified as follow:

Pot handle design

1. Designing a wrist handle to improve the use of flexibility.
2. A handle with a waveform for carrying heavy cookware ergonomically.
3. Design with a groove where the thumb rests to generate force easily.

Chopping board design

1. Half sphere and cylinder groove with shortened teeth to grip ingredients safely.
2. Left and right-hand orientation designs for chopping should be considered.
3. Groove placement for bowls to apply more force for other cooking activities.

Overall, both redesigns of the handle and chopping board could be an example to show alternative design perspectives to cope with the cooking challenge of carrying heavy cookware and processing ingredients with one hand ergonomically and systematically.

5 CONCLUSIONS

Due to physical limitations, people with hand disabilities often face challenges related to the biopsychological approach and social exclusion, could impact their mental well-being negatively. To assist them in building positive values and self-esteem, cooking activities, particularly soup cooking, could be an alternative way to express support for their love independently and gain a sense of accomplishment because cooking is not only a multi-tasking complex housework duty but also could

be a professional technique and create the opportunity for people gathering. Soup cooking were addressed in this research, as it is the major cooking element in Hong Kong and involves two major one-hand cooking challenge activities, carrying heavy cookware and processing ingredients. To provide a clear framework for designing cooking utensils for hand impairment, a pot handle design and the form of a chopping board have been designed as an example for testing. Since both disabled cooking utensils of the pot and chopping board are conceptual designs to identify the design framework for hand impairment, the general perspective of those works would be analysed further in order to create a better cooking platform for them as well as enhancing their self-esteem.

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