ORIGINAL ARTICLE

Evaluation of Existing Walking Sticks and Recommendations for Modified Walking Stick

Piyali Sengupta[1], Kiran Mondal[2], Hiranmoy Mahata[3], Sujaya De[4], Prakash C Dhara[5]

Abstract

Purpose: Evaluation of the existing walking stick and recommendations for modified walking stick from the viewpoints of ergonomics.

Materials and methods: Subjective evaluation was used by preparing a standard questionnaire.

Results: 100% patients need modification in existing walking stick, 30% reported that the stick is too long to use, 30% reported that the handle was slipping out while in use, 26% felt that the stick is too heavy to them, whereas others reported palm and figure injury in long-term use of walking stick. In all, 54% reported slipping out of the stick on the floor, and 66% preferred cane as the stick material.

Conclusion: The present study concluded that the elderly population need modification in existing walking sticks. The slipping rate of the stick could be minimized by adapting some modifications in the stick. Cane is preferred as the stick material in the studied population.

Keywords: Designing approach, Elderly, Subjective evaluation, Viewpoints of ergonomics, Walking stick.

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Introduction

Walking stick may be a good assistive device to support the elders and enable them to overcome many of the motion-related problems (e.g., walking, stair climbing, changing posture, pain and discomfort, etc.). Some efforts have been made by the researchers to establish the need for assistive devices to support the elders. In previous studies, researchers pointed out that maintaining mobility is one of the preventive methods against falls, and fear of falling has been identified as an important factor that leads to activity restriction.[1–6] Some studies said that cane is often bought for balance and support[7–9] which in turn overcomes falls and fear of fall. Others studies have argued that the use of the walking stick may actually increase the risk of falling by causing tripping or impeding on the balance control mechanisms after a perturbation.[10] It has also been reported that 30–50% of people abandon their device soon after receiving it.[11] Studies have also concluded that long-term use of cane caused enough repetitive stresses to highly increase the chances to repetitive strain injuries, such as tendonitis and carpal tunnel syndrome.[11] To answer the abovementioned problems, Diez[12] experimented with the use of a few canes and concluded that most canes lack basic ergonomic principles. So if we overcome those problems, then a walking stick would be an ideal friend for elderly who they can believe blindly.

Today, walking sticks are overwhelmingly used by the elderly individuals who need assistance in walking.[13] By holding a stick or cane either in the dominant hand or in the hand opposite to the weakness or injury, the user can shift his or her weight away from the weaker side of the body.[14]

From the abovementioned discussion, it was observed that there were many drawbacks of the existing walking sticks. So, to overcome those drawbacks researcher have to build up some recommendations from the viewpoints of ergonomics. In the present study, an attempt was made to evaluate existing walking sticks and its related issues among Indian elderly population. After that the key recommendations would build up for approaching a new walking stick.

[1,3–5]Department of Human Physiology with Community Health, Ergonomics and Sports Physiology Division, Vidyasagar University, Midnapore, West Bengal, India

[2]Department of Ergonomics Group, Defence Institute of Physiology and Allied Sciences, Defence Research and Development Organisation, Timarpur, Delhi, India

Corresponding Author: Prakash C Dhara, Department of Human Physiology with Community Health, Ergonomics and Sports Physiology Division, Vidyasagar University, Midnapore, West Bengal, India, Phone: +91 3222 276554, e-mail: prakashdhara@rediffmail.com

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Materials and Methods

Selection of Site and Subjects

Present study was conducted in different urban and rural areas among West and East Midnapore, Bankura, and South 24 Pargana districts of West Bengal, India. Total 50 individuals (male-31 and female-19) were selected for the study having the age range 61 years and above. To maintain the quality of the study, sample size was limited to 50. All the individuals were volunteered for the study. Informed consents were obtained from the individuals. Before performing the study, ethical approval and prior permission were obtained from the Institutional Ethical Committee, and the study was performed in accordance with the ethical conditions of the committee.

Study Design

In the study, two-stage sampling method was utilized. In the first stage, a cluster sampling method was used to identify four clusters in each district (mentioned above) of West Bengal, India. In the second stage, a systematic random sampling method

was used to identify 15 families per cluster, and it should be mentioned here that there should be at list one walking stick user (having the age range mentioned above) in the selected family. All families in the cluster were listed, and the number of families was divided by the required number of families to obtain the sampling interval. The first family was selected randomly using a lottery method, and then subsequent families were identified by adding a sampling interval to the random number. The selected families were approached during field visits, and the protocol of the study was explained verbally in the local language (Bengali), and the available walking stick users were selected as participants. Participants were interviewed at their respective families.

Inclusion and Exclusion Criterion

Healthy individuals without having any known disease, acute illness, not under any prolonged medication, and not having undergone any recent surgery are participated in the study. However, the individuals having health problems related to old age (age range mentioned above) are included within the study.

Persons who had visual, hearing, or cognitive impairments or a history of cancer, physically handicapped, and physically disabled were excluded from the study.

Subjective Evaluation

Elderly persons were found to use the conventional walking sticks, which had various shape and size. Those sticks were evaluated to assess advantages and disadvantages of using them.

A standard questionnaire was prepared in this regard which was tending to concentrate on information from observation and self-report. The data were generally descriptive, focusing on the percentage of the individuals expressing a certain opinion.

Results

The results of the present study are presented in Table 1 and Figure 1. The results of the evaluation is summarized in Table 2 and 3 showed the recommendations of the study.

It was observed from the results that 100% participants reported that they need assistive device to perform their daily activities and the type of assistive device should be a walking stick. Most of the elderly persons (98%) felt reduced problem during walking while using a walking stick. In all, 80% elderly patients reported different types of problems during handling their own walking stick. In all, 100% reported that the drawbacks of their own walking sticks should be properly evaluated and modified (Table 1). In all, 50% of participants reported that they keep their sticks beside a table or any other support available in the room while not in use. In all, 36% of individuals used their walking stick for multiple purposes, e.g., at indoor work station, and outdoor work station as well as during changing different postures (Table 1).

Elderly persons used their walking stick at different types of surfaces but mostly at rough surface (22%) (Table 1). In all, 30% participants reported that the existing stick was longer than their preference. They also feel that the stick was heavy, and the shaft is thick (22%). In all, 30% of the participants reported that the handle is slipping out from the griping area, 14% reported palm injury, and 6% reported finger injury while griping the handle repeatedly. In all, 26% of the participants reported that the stick they use was too heavy to use (Table 1), and 66% individuals preferred cane as the stick material (Fig. 1).

Discussion

Previous studies have reported that the elderly persons prefer to spend their later years in their own homes. But there are some environmental barriers as well as physical barriers that indeed threaten the elderly to restrict them to age in place. Use of assistive technologies can remove those barriers and on the other hand enhance the individual's mobility and ability to carry out activities of daily living (ADL) and so also the social activities.[15]

In the present study, 100% participants reported that they need walking stick to support themselves to perform ADL. Thereby, a walking stick should meet the requirements of the user population, and then only the stick could assist the elderly persons from mobility and balance-related problems.[11,16,17]

In the present study, a higher percentage of the subjects reported that the problems during walking is reduced while using a walking stick, but at the same time 100% persons reported that they need modifications in their own walking stick. A variety of walking sticks are available in the market having different quality, design, and suitability. When designing for an elderly individual, it should be kept in mind what are the reasons behind the use of a walking stick. Probably, the reasons are to maintain body posture, to provide stability and balance, to increase their self-confidence, and to distribute the body weight of the user.[18]

In the present study, higher percentage of individuals reported that they faced different types of problems while using their own walking stick. Although the elderly persons use the walking stick as a supporting device, one of the striking problems of using conventional walking sticks was the slipping of sticks on the floor during walking. This might be a dangerous problem for an elderly user. So, when designing for an elderly, it should be remembered that the provision for a ferrule (the rubber stop at the end of the stick) should incorporate at the stick tip to grip the surface and to provide better stability to the user.[11,16,17,19] The literature said that if a walking stick fitted with a rubber tip (ferrule), it would increase the friction, and this friction would determine the angle between the stick shaft and the vertical position where the slipping would occur.[20–22]

Elderly persons reported problems of handling the stick while not in use. It might be in the short interval between two sessions of walking or in long interval between two sessions of personal work or other tasks. So, while designing, it should kept in consideration that there should be a provision of holding the stick during leisure time.

In the present study, a higher percentage of the individuals used their walking stick at different places and different surfaces, e.g., at indoor and outdoor work stations and so also during changing different postures. So while designing it should be remembered that a walking stick could be used at different places and different surfaces, and there should be a provision on the stick to use it during changing of postures.

Regarding the dimensions, 30% of elderly individuals reported that the existing stick was longer than their preference. A wrong stick height puts strain on the upper limb and also in the trunk region.[11,16,17,22] In the present study, the user population felt that the stick was heavy, and the shaft of the stick is thick. Walking sticks available in the market are single point, tripods, and quads. Among them, tripods and quads give a better rotational stability than that of the single point stick; however, there was some demerits to use those sticks. Although quad canes are expected to apply a higher load, but as the legs of the quad canes are added and widened, the canes become heavier and may become a problem for the elders

Table 1: Frequency and percentage of elderly persons reported existing walking stick related issues ($n = 50$)

Walking stick related issues	*Parameters*	*Frequency (%)*
Need support for walking	Need support for walking	50 (100)
	Preferred walking stick as supporting device	50 (100)
	Reduced problem when using walking stick	49 (98)
	Have own walking stick	50 (100)
Problems while using walking stick	Felt uncomfortable while using walking stick	40 (80)
	Slipping of walking stick on the floor during use	27 (54)
	Used to forget for taking walking stick	34 (68)
	Favouring modification of conventional walking stick	50 (100)
Handling of walking stick while not using it	Kept the stick in hand	9 (18)
	Kept the stick any other places in the room (other than hand)	16 (36)
	Kept with any support (table/corner of the wall etc) adjacent to the user	25 (50)
Using walking stick at different places/working conditions	Indoor	1 (2)
	Outdoor	8 (16)
	During work	0 (0)
	Changing posture	0 (0)
	Both indoor and outdoor	14 (28)
	Indoor, outdoor and changing posture	16 (36)
	Outdoor and any work	7 (14)
	Indoor, outdoor and any work	2 (4)
	Outdoor and work station	2 (4)
Using walking stick at different surfaces	Rough	11 (22)
	Mosaic	1 (2)
	Cement	6 (12)
	Soil	3 (6)
	Sloppy	5 (10)
	Rough, soil and sloppy	9 (18)
	Mosaic and sloppy	5 (10)
	Mosaic, cement and sloppy	10 (20)
Dimensional characteristics and problems of holding during using walking sticks	Long	16 (32)
	Short	9 (18)
	Heavy	13 (26)
	Light	5 (10)
	Thick	13 (26)
	Thin	4 (8)
	Sharp	3 (6)
	Unclean/rough surfaced	13 (26)
	Blunt	10 (20)
	Grooved	6 (12)
	Slipping out of the handle	15 (30)
	Finger injury	3 (6)
	Palm injury	7 (14)

with decreased muscular strength. In a study, it was concluded that the peak and mean forces on the single-point cane and the tetrapod were not found to be statistically different.[23] So, a single point walking stick could be a better option for an elderly user.

In the present study, most of the elderly individuals had reported that they faced different types of problems with the handle. Some had reported slipping out of handle from the grip, and some reported palm and figure injury in long-term use. Badly fitted walking sticks can give injuries and make it more difficult for the user to walk.[11,22] A variety of walking sticks are available in the market having various handles. Handle is the part that interfaces between the user and the stick and strongly determines whether the integration of the stick as fifth limb is successful or not. So while designing, the researcher should keep in mind that the handle of a walking stick should conforms the shape of the hand, the handle should that much large that the pressure of the upper limb can spreads all over the handle through the hand, the handle should be designed in such a way that the wrist should be at its neutral

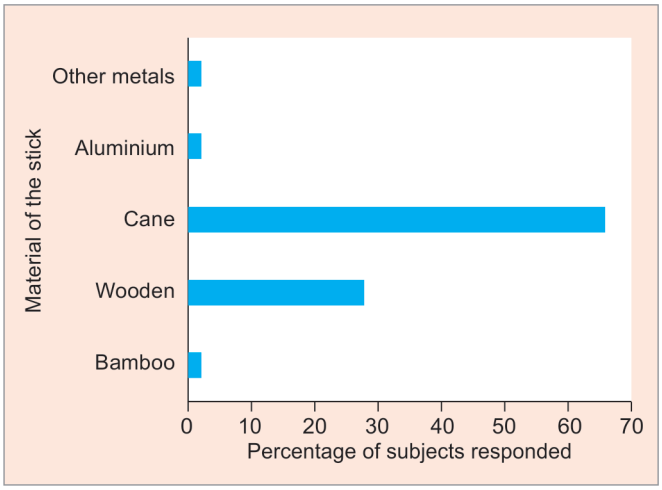

Fig. 1: Percentage of elderly subjects using different stick materials

Table 2: Summary of the evaluation of existing walking stick from subjective evaluation ($n = 50$)

Parameter	*Percentage*
Most of the elderly persons felt problem while using walking stick	80
More frequently used walking stick in indoor, outdoor and changing posture	36
Vital problems of walking stick: long; thick handle; and heavy	30; 22; 22
Elderly persons favoured modification of walking stick	100
Slipping rate of walking stick is high during its use	54
Elderly persons kept their walking stick beside a table or other support while not walking	50
Elderly persons used to forget to take walking stick during resting	68
Maximum elderly persons favoured cane as stick material	66

position and minimizes any kind of deviations of the wrist[20–22] which helps the user to grip the handle with minimum grip strength.[12] A handle that is ergonomically designed can spread the weight of the body across the hand instead of one single area.[10,11,16] The curved handled cane is very famous among elderly cane users, and in Indian Bengali population it is commonly known as "Dadur Lathi." In previous days, these curved handled sticks were used, and the advantage of those sticks were in leisure time the stick can be slung on an arm (or table) with that curved handle. But this type of handle could not provide an easier grip to use the stick in a comfortable way.[11,16–18] In the year 1988, Mulley states that the curved wooden sticks are adequate for short-term use but can create pressure on the base of the palm and are not recommended for long-term use in chronic conditions. So while designing, a researcher should think properly how to design the handle as it is an important part of a walking stick.

The walking sticks with different materials are available in the market. The results of the present study revealed that a higher percentage of user population preferred cane as the stick material. Cane is any of various tall, perennial grasses with flexible, woody stalks and more specifically from the genus *Arundinaria*. *Arundinaria*,

Table 3: Recommendations for designing of a new walking stick from the viewpoints of ergonomics

Results summarized	*Recommendations*
Most of the elderly persons felt problem while using walking stick and need modification	Before designing, the reasons behind using walking stick by an elderly, should properly be evaluated.
Slipping of walking stick on the floor during use	Incorporation of a rubber ferrule (tip) at the end of the stick can grip the surface properly and provide better stability to the user.
Handling of walking stick while not using it	There should be a provision of holding the stick while not using it.
More frequently used walking stick in indoor, outdoor and changing posture	A walking stick could be used for multiple purposes.
Using walking stick at different surfaces	Proper designing of stick tip and incorporation of rubber ferrule.
Vital problems of walking stick: Long; thick handle; and heavy	Proper height and weight of a walking stick is required for comfortable use.
Slipping out of the handle, figure injury, palm injury	The handle of a walking stick should be covered with anti-slipping material. The dimensions and the angle of the handle with the stick shaft should be designed from the viewpoints of ergonomics.
Maximum elderly persons favoured cane as stick material	The merits of cane stick are light weight, long lasting and safe for using.

commonly known as the canes, is the genus of bamboo in the grass family. According to users, the cane stick was of light weight, long lasting, and safe to use.[24]

Recommendations widens the scope of solution and hence are useful for designing a product. As because an assistive device is used by those elderly who are either dependent or assisted to do their daily activities, the researcher should keep in mind the criterions of the assistive device which the elderly prefer to have to maintain independent living. In the present study, an attempt had been taken to build some key recommendations that could not only help a researcher in future aspects but also help the walking stick manufacturer to design a walking stick from the viewpoints of ergonomics.

Conclusion

The study concluded that there is a need of modification in existing walking sticks available in the market. A walking stick should meet the requirements of the user population. Say for example in the present study: user population preferred a ferrule at the end of the stick to reduce the rate of slipping out of the stick on the floor, they want a provision of holding the stick while not in use, they want their stick should have a proper height and weight for easy handling, they want cane as the stick material, and finally they need to use their stick in different surfaces, whereby the stick should be designed in such a way that it could not slipped out from the floor. Keeping those points in mind some recommendations were build

up in the study with the help of ergonomic principles to open up further research on the field for the satisfaction of the walking stick user population.

What We Already Know and What We Learn from the Article

We know that use of walking stick can help the elderly in their daily activities. We know that there are different types of walking sticks available in the market and we also know that those existing walking sticks are safe and easy to use and meet user satisfaction.

But what we do not know and should learn from the article are-

Walking stick can help the elderly in their daily activities only if the walking stick is user-friendly. Definitely different types of walking sticks are available in the market having different ranges, but the question arises here does those sticks meets ergonomic principles? If not then there is no safety and no satisfaction at all to use those existing walking sticks.

We learn some recommendations from the study. And hopefully these recommendations will definitely help the researcher in future aspects but it will also help the manufacturer to design a walking stick from the viewpoints of ergonomics. So that the modified walking stick could be safe and handy to use according to the user satisfaction.

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