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장애인 전동보조기구 사고 및 관리현황에 관한 연구

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The Status of Accidents and Management for Electronic Assistive Devices among the Handicapped

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<Abstract>

Objectives : The purpose of this study was to investigate accident cases involving electronic assistive devices, to determine how these accidents can be avoided and to devise preventative instructions for the handicapped who use these devices. **Methods** : This study was carried out from July 20 to October 3, 2015. A consent-based survey was conducted via mail and mobile phones targeting 700 electronic assistive device users, of which questionnaires from 290 users were collected and used in the analysis. **Results** : Accidents involving electronic assistive devices were investigated, especially the causes of the accidents and accident prevention education, as well as the status of the electronic assistive devices. The most common accident types were collision and falling, and it was found that the victims of the accidents usually suffered severe injury to their lower limbs. Most users used electronic assistive devices every day but rarely wore a safety belt because of discomfort. There were more incidents of collision and falling for older aged handicapped users, and the injury rate to the lower limbs was highest in handicapped elderly aged 50 years or older. **Conclusions** : In order to prevent accidents with electronic assistive devices in the future, a or management organizations must prepare specific safety guidelines and manage these accidents.

Key Words : Electronic Assistive Devices, Accident, Handicapped

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Ⅰ. Introduction

To keep pace with changes in disability policies, assistive devices for the handicapped have become an important means of ensuring the social participation of handicapped. As the disabled population increases and the disability category expands owing to acquired factors, the number of elderly people requiring assistive devices has increased suddenly in recent years, and the demand for assistive devices for the handicapped are increasing day by day as well[1]. Among the 79 items listed as assistive devices for the handicapped, electric wheelchairs and electric scooters are classified as electronic assistive devices. These items have been provided as insurance benefits since 2005. The government supports 90% of a device's cost, meaning the lowest price among the base amount, the official price, and the actual purchase amount. When a device is purchased for a disabled person who has a rare incurable disease, 100% of the base amount is supported[2]. Electric wheelchairs and scooters are used by people who cannot walk, or whose arm movement is weakened or completely lost, or cannot operate a manual wheelchair[3]. Most electronic assistive device users are patients with a physical disability, brain lesion, heart failure, or respiratory failure. The use of electronic assistive devices is increasing owing to national support and, as a result, the rate of accidents involving electronic assistive devices is also increasing[4].

According to a press release, during the first half of 2015, the accident rate for users of electronic assistive devices increased, and institutional measures are urgently required to minimize this trend. Various safety-related studies concerning electronic assistive devices have been carried out to analyze the rate and causes of accidents; however, Korean studies have been conducted at a very limited level[5]. In principle, electric wheelchairs are not recognized as "cars" in the Road Traffic Act; therefore, by law, they should be operated on the sidewalk. However, many electric wheelchair users find it safer to drive on the road because of sidewalk obstacles such as curbs, uneven pavement, or billboards erected on the roadside[6]. In the event of a traffic accident caused by using such an unsafe road, however, no defensive measures can be taken. Given this situation of increased accident risk, it is necessary to establish a support system policy to compensate handicapped victims who are involved in road accidents. In reality, national support is difficult to obtain at the institutional level. Therefore, it is critical that guidelines be established for the prevention of accidents involving electronic assistive devices, as well as measures for dealing with traffic accidents involving electronic assistive devices[7]. Most new purchasers of electronic assistive devices do not receive proper safety education, and routine follow-up is lacking. Furthermore, there has been no research on accident prevention education for users of electronic assistive devices. Hence, in this study, accident cases involving electronic assistive devices were investigated to determine how accidents can be avoided, and to devise instructions for preventative measures for the

handicapped of these devices.

Ⅱ. Method

1. Subjects

In this study, 900 of the 31,848 handicapped registered in the National Health Insurance Service as users of an electronic assistive device were selected to complete a survey via mobile methods or mail under consent. The survey was based on the convenience sampling method, a nonprobability sampling method. The final 290 completed questionnaires were collected from July 10 to October 3, 2015.

2. Measurements

The questionnaire used in this study was constructed with reference to the studies of Lee[8] and Jung[9] and was developed through consultation with an assistive technology professor. The main content of this questionnaire consisted of general information, the status of electronic assistive device management, research on the status of accidents involving electronic assistive devices, and the status of prevention education for electronic assistive devices. During the development of the questionnaire, a preliminary test was carried out with 20 assistive technology experts, and questions not properly conveying the examiner's intention, or questions that were difficult for examinees to understand, were modified.

3. Ethical Considerations

The data used in this study were collected from a structured self-reported questionnaire survey from July 20 to October 3, 2015. All details of this study's procedures were submitted to the Science Research Council of Inje University. The IRB number is 2-1041024-AB-N-01-20150518-HR-245.

4. Analytical Methods

The research data collected were analyzed using SPSS ver. 19.0. Descriptive statistics were used to determine the general characteristics of the subjects, the status of accidents involving electronic assistive devices, and the status of prevention education, accident situations by the subjects.

Ⅲ. Results

1. General Characteristics

More men(55.5%) participated in the survey than women, and the age ranges were on the order of 50s(27.6%), followed by 40s(25.2%), and then 60 or older(23.1%). The majority of subjects −179(61.7%)−were unemployed. The most common type of disability was physical disability(65.5%), followed by brain lesion disorder(32.7%). Disability ratings were on the order of 1st(50.3%), 2nd(22.8%), and 3rd(16.2%), while a slight majority of the subjects hand a disability for a 10~20 year period(51.7%), as listed in <Table 1>.

<Table 1> General characteristics of subjects (N=290)

	Item	N	%
Gender	Men	161	55.5
	Women	129	44.5
Age	1~19	11	3.8
	20~29	23	7.9
	30~39	36	12.4
	40~49	73	25.2
	50~59	80	27.6
	60 or older	67	23.1
Occupation status	Yes	111	38.3
	No	179	61.7
Type of disability	Physical disability	190	65.5
	Brain lesion disorder	95	32.7
	Respiratory disorder	5	1.8
Disability rating	1st	146	50.3
	2nd	66	22.8
	3rd	47	16.2
	4th	20	6.9
	5th	6	2.1
	6th	5	1.7
Disability period	10~19	150	51.7
	20~29	70	24.1
	30~39	16	5.5
	40~49	34	11.7
	50 or more	20	6.9

2. Status of Accidents Involving Electronic Assistive Devices

According to the results on the status of accidents involving electronic assistive devices, 171 users(58.9%) had experienced an accident. The types of accidents were collisions and falling down, and lower limbs(43.3%) were the most commonly damaged body parts. Treatment took two to four weeks(50.3%) in most cases. The causes of the accidents were careless product operation(42.7%), traffic accidents(34.5%), and mechanical defects(13.5%). Half of the safety accidents occurred on roads(50.3%), and at the time of the accident, users were either moving(56.7%) or transfer(24.0%). The most common length of use of an electronic assistive device at the time of an accident was less than two years(49.7%), while once or twice per year was the most common frequency of safety accidents, as shown in <Table 2>.

3. Status of Electronic Assistive Device Management and Prevention Education

The distribution of the type of electronic assistive device used was 57.5% for electric wheelchairs and 42.5% for electric scooters. The most common total length of time using the device was 1~3 years(53.5%). When subjects were asked about the regular management of their electronic assistive device after purchase, "I do not manage it" (69.0%) was the most common response, and the reasons for not managing it were "do not know how to"(51.5%), "hard to manage"(35.0%), and "burden of cost"(20.3%). With regard to the wearing of a safety belt, "hardly wear"(52.4%) was the highest response, while most subjects stated that they did not wear one because it was inconvenient. More than half of the subjects had received accident prevention education for their electronic assistive device(56.8%). Concerning the need for accident education, opinions were in the order of necessary(33.8%), very necessary(25.0%), and somewhat necessary (17.2%), with all opinions expressing some degree of necessity(76.5%) that accounted for a large majority. With regard to teaching methods for accident prevention, the most common opinion was that instructor-led hands-on training was the most appropriate method, and safety education should be carried out by the product supplier(39.6%)<Table 3>.

<Table 2> Status of accidents involving electronic assistive devices (N=290)

Item		N	%
Occurrence of accident	Yes	171	58.9
	No	119	41.1
Type of accident (n=171)	Collision	89	52.0
	Falling	64	37.4
	Fall down	11	6.4
	Crushing injury	5	2.5
	Others	2	1.7
Area injured during accident (n=171)	Lower limb	74	43.3
	Upper limb	50	29.2
	Head	39	22.8
	Trunk	5	2.9
	Others	3	1.8
Required treatment period (n=171)	One day	37	21.6
	3 days~1 week	19	11.1
	2 weeks	14	8.2
	2~4 weeks	86	50.3
	More than one month	15	8.8
Cause of accident (n=171)	Traffic accident	59	34.5
	Mechanical defects	23	13.5
	Careless product operation	73	42.7
	Physical environment	12	7.0
	Others	4	2.3
Accident location (n=171)	Home	52	30.4
	Road	86	50.3
	Medical and welfare facilities	7	4.1
	Commercial facilities	24	14.0
	Others	2	1.2
Activity of passengers during an accident (n=171)	Moving	97	56.7
	Transfer	41	24.0
	Reaching activity	3	1.8
	Using a door	18	10.5
	Others	12	7.0
Electronic assistive device use experience at the time of the accident (n=171)	Less than 2 years	85	49.7
	2~3 years	50	29.2
	3~4 years	26	15.2
	4~5 years	7	4.1
	More than 6 years	3	1.8
Frequency of safety accident occurrence (n=171)	1~2 times a year	133	77.8
	3~4 times a year	27	15.8
	1~2 times a month	10	5.8
	3~4 times a month	1	0.6

<Table 3> Status of electronic assistive device management and prevention education (N=290)

Item		N	%
Electronic assistive device	Electric wheelchairs	167	57.5
	Electric scooters	123	42.5
Total period of device use	Less than 1 year	41	14.1
	1~3 years	155	53.5
	3~5 years	50	17.2
	5~7 years	15	5.2
	7~9 years	25	8.6
	More than 9 years	4	1.3
Status of electronic assistive device management	Managing	90	31.0
	Not managing	200	69.0
Management methods(n=90)	Checking after going out	47	52.2
	Checking air in tire	22	24.4
	Requesting company assistance	21	23.4
Reasons for not managing(n=200)	Do not know how	103	51.5
	Hard to managing	70	35.0
	Burden of costs	27	13.5
Frequency of wearing a seat belt (n=200)	Always wear	46	15.9
	Frequently wear	86	29.7
	Hardly wear	152	52.4
	Do not wear at all	6	2.1
Reasons for not wearing a seat belt(n=158)	Uncomfortable	125	79.1
	Lowered awareness of accident risk	33	20.9
Experience of accident prevention education	Yes	125	43.2
	No	165	56.8
Need for accident education	Very necessary	74	25.5
	Necessary	98	33.8
	Normal	50	17.2
	Unnecessary	44	15.2
	Very unnecessary	24	8.3
Appropriate accident prevention teaching methods(n=222)	Instructor-led theory education	52	23.4
	Instructor-led hands-on education	102	45.9
	Internet lecture	28	12.6
	Distribution of educational booklets	38	17.1
	Others	2	0.9
Person responsible for education(n=222)	Staff of National Health Insurance Corporation	64	28.8
	Product supplier	88	39.6
	Prescribing doctor	24	10.8
	Assisting device related expert	39	17.6
	Others	7	3.2

4. Accident Status According to General Characteristics

1) Areas of Injury According to General Characteristics

The damage rate to lower limbs was highest for subjects under 50~59 years of age, while the damage rate to upper limbs was highest for subjects under 40~49 years of age. For employed handicapped, mainly lower limbs were damaged in accidents. Likewise, handicapped with a 1st rating mainly suffered from damage to lower limbs. See <table 4>.

<Table 4> Accident-related area of injury according to general characteristics (N=171)

Item		Frequency (%)				
		Lower limb	Upper limb	Head	Trunk	Others
Gender	Men	47(27.5)	38(22.2)	31(18.1)	4(2.3)	2(1.2)
	Women	27(15.8)	12(7.0)	8(4.7)	1(0.6)	1(0.6)
Age	1~19	-	11(6.4)	-	-	-
	20~29	6(3.5)	3(1.8)	9(5.3)	-	-
	30~39	20(11.7)	5(2.9)	3(1.8)	3(1.8)	1(0.6)
	40~49	18(10.5)	20(11.7)	17(9.9)	1(0.6)	-
	50~59	23(13.5)	10(5.8)	10(5.8)	1(0.6)	2(1.2)
	60 or older	5(2.9)	3(1.8)	-	-	-
Occupation status	Yes	43(25.1)	28(16.4)	13(7.6)	4(2.3)	3(1.8)
	No	31(18.1)	22(12.9)	26(15.2)	1(0.6)	-
Type of disability	Physical	29(28.7)	40(23.4)	37(21.6)	3(1.8)	2(1.2)
	Brain lesion	24(14.0)	10(5.8)	2(1.2)	2(1.2)	1(0.6)
	Respiratory	1(0.6)	-	-	-	-
Disability rating	1st	48(28.1)	37(21.6)	18(10.5)	3(1.8)	3(1.8)
	2nd	16(9.4)	6(3.5)	21(12.3)	1(0.6)	-
	3rd	7(4.1)	5(2.9)	-	-	-
	4th	-	2(1.2)	-	1(0.6)	-
	5th	2(1.2)	-	-	-	-
	6th	1(0.6)	-	-	-	-
Disability period	10~19 years	53(31.0)	28(16.4)	22(12.9)	4(2.3)	3(1.8)
	29~29 years	11(6.4)	5(2.9)	9(5.3)	-	-
	30~39 years	-	1(0.6)	-	-	-
	40~49 years	9(5.3)	15(8.8)	-	1(0.6)	-
	More than 50 years	1(0.6)	1(0.6)	8(4.7)	-	-

2) Difference in Causes of Accidents According to General Characteristics

Traffic accidents were the most common cause of accidents among handicapped aged 40 or older, while careless product operation was the most common cause of accidents among handicapped who were 30~39 years of age. For those who were employed, accidents caused by careless product operation were the most common, and this accident rate increased among users with a shorter disability period. See <Table 5>.

<Table 5> Causes of accidents according to general characteristics (N=171)

	Item	Frequency (%)				
		Traffic accident	Mechanical defects	Careless product operation	Physical environment	Others
Gender	Men	43(25.1)	15(8.8)	50(29.2)	10(5.8)	4(2.3)
	Women	16(9.4)	8(4.7)	23(13.5)	2(1.2)	-
Age	1~19	11(6.4)	-	-	-	-
	20~29	1(0.6)	8(4.7)	9(5.3)	-	-
	30~39	2(1.2)	1(0.6)	25(14.6)	4(2.3)	-
	40~49	21(12.3)	4(2.3)	23(13.5)	6(3.5)	2(1.2)
	50~59	21(12.3)	9(5.3)	12(7.0)	2(1.2)	2(1.2)
	60 or older	3(1.8)	1(0.6)	4(2.3)	-	-
Occupation status	Yes	26(15.2)	10(5.8)	52(30.4)	1(0.6)	2(1.2)
	No	33(19.3)	13(7.6)	21(12.3)	11(6.4)	2(1.2)
Type of disability	Physical	48(28.1)	15(8.8)	59(34.5)	7(4.1)	2(1.2)
	Brain lesion	11(6.4)	8(4.7)	14(8.2)	4(2.3)	2(1.2)
	Respiratory	-	-	-	1(0.6)	-
Disability rating	1st	33(19.3)	18(10.5)	52(30.4)	5(2.9)	1(0.6)
	2nd	21(12.3)	4(2.3)	16(9.4)	1(0.6)	2(1.2)
	3rd	2(1.2)	1(0.6)	5(2.9)	4(2.3)	-
	4th	1(0.6)	-	-	1(0.6)	1(0.6)
	5th	1(0.6)	-	-	-	-
	6th	1(0.6)	-	-	-	-
Disability period	10~19 years	21(12.3)	19(11.1)	60(35.1)	7(4.1)	6(1.8)
	20~29 years	14(8.2)	4(2.3)	7(4.1)	-	-
	30~39 years	-	-	1(0.6)	-	-
	40~49 years	15(8.8)	-	4(2.3)	5(2.9)	1(0.6)
	More than 50 years	9(5.3)	-	1(0.6)	-	-

Ⅳ. Discussion

Among OECD countries, Korea is recognized as a country with a high accident rate for handicapped who use electronic assistive devices[5]. Although the accident rate of electronic assistive device users is increasing, there are no current institutional measures in place to resolve this issue. Hence, the reduction of the accident rate and measures to prevent accidents were evaluated in this study, which investigated whether electronic assistive devices were being used safely and reviewed the accident characteristics of users.

The number of people using electronic assistive devices is continuously increasing. Likewise, the number of electronic-assistive-device-related accidents is increasing steadily. Consumer complaint consultations deal mainly with quality and follow-up management. Complaints about quality include the automatic discharge of batteries or defective charging, wheels falling off, or uneven wear. Sudden stops during operation and malfunctions also account for a considerable number of complaints[10]. In the United States, many accidents have resulted owing to an increase in the operating speeds of electronic assistive devices. If a road is suddenly closed while a person is driving at high speed, or an impassable sidewalk is encountered, the risk of an accident increases. This speed control problem may cause injuries to pedestrians as well as to the electric wheelchair operator[11]. In Japan, electric wheelchair use by the elderly and handicapped has rapidly spread owing to ease of operation, but according to statistics, between 2008 and 2012 more than 200 traffic accidents happened each year. This indicates that more attention to user safety is required[6].

As shown in this study's results, the common accident types include collisions, falling, falling down, and damage to lower limbs. Damage to the lower limbs was found to be severe in most cases when such accidents occur. In an inquiry conducted by the Korea Consumer Agency in 2011[12], lower limbs accounted for the highest proportion of damaged body parts owing to accidents involving electronic assistive devices. It is believed that the higher risk of damage to lower limbs is a result of the reduced controllability of pelvic limbs by paralysis. Looking at accident cases, most accidents are caused by falling and falling down in homes or on roads, and it takes more than one month of treatment to recuperate in most cases. In order to reduce this risk, it is necessary to educate users on subjects such as product operation, precautions when driving outside, and defective equipment checks, because most handicapped and elderly people recover slowly from fractures and enter[3]. In this study, the most frequent cause of accidents was careless operation, which means that follow-up management, such as consulting and education, is not being properly done. Hence, regular and mandatory inspections and follow-up management, such as an aptitude test for driving licenses and periodic device inspection, should be immediately introduced to handicapped who use electronic assistive device[13]. Most users were found to use electronic assistive devices every day, but rarely wore a safety belt owing to discomfort. Lack of

safety equipment and user carelessness may lead to a serious accident. Therefore, it is necessary to prepare for this and improve users' safety awareness[14].

Looking at the status of accident prevention education for electronic assistive devices, most users did not receive any education, indicating that prevention education is not conducted well. However, the majority of handicapped thought that accident prevention education was needed, and most disabled people wanted to learn about situations in which they should be careful through guided hands-on training. Thus, it is necessary to conduct hands-on traffic safety training regularly for seniors' groups and disability organizations[15][16].

Looking at the general characteristics of accidents, there were more collisions and falls at older ages, and the injury rate to the lower limbs was higher among handicapped aged 50 or older. The most common causes of accidents for disabled people aged 40 or older were traffic accidents, while accidents resulting from careless product operation were most common among handicapped in their 30s. The highest accident rate was found among men in their fifties[17]. Moreover, in the United States 2000 Census, the highest accident rate of 17.7% was observed in the over-65 age group[18]. Taking safety precautions is especially important because of the potential for lower-limb damage to elderly people with handicapped[19]. Furthermore, many accidents are caused by careless operation among users with shorter disability periods, and therefore continuous education for the safe use of electronic assistive devices should be conducted.

Reflecting on these results, the following matters should be addressed at the policy level to prevent accidents involving electronic assistive devices in the future. First, it is necessary to place a warning(safety marker) on electronic assistive devices in order to prevent accidents such as falling or falling down. Program development and safety education for the proper use of electronic assistive devices should be regularly carried out by related agencies or local governments. This education should cover such topics as device structure and precautions when moving, and should target electronic assistive device users and caregivers.

Second, the majority of users are unaware of the appropriate responses because there is no specific training provided in Korea for the safe operation of electronic assistive devices. Moreover, there is a higher risk of accidents in Korea owing to the poor pedestrian environment. Although education on theory and the distribution of booklets would be good measures to educate users on accident prevention and enhance operational experience, the most effective measure would be education through practical exercises. Regular practical traffic safety education is necessary for the elderly and disabled. Moreover, by providing systematic safety instructions about the use of electronic assistive devices, users will have to be certified before and after use of electric assistive devices. Safety guidelines should include clear and organized content on all processes from device repair requests to the completion of repair and follow-up management[3]. In addition,

prediction standards for unexpected situations and usage patterns associated with safety, such as safety belts, must be learned.

Third, since many accidents occur on bumpy surfaces or uneven slopes, it is necessary to create an environment that electronic assistive devices can safely traverse. The recent barrier-free movement in Korea provides comfortable and safe living facilities for seniors and physically challenged people; the architectural design of these accommodations and the surrounding environment make mobility easier and safer. When this type of environmental consideration becomes widespread, the independence and quality of life for handicapped will be enhanced[20].

Finally, in order to prevent accidents involving electronic assistive devices, it is necessary to establish standards for strengthening the quality of these devices. In 2013, the Korea Consumer Agency announced that a considerable number of electric wheelchairs had safety issues and did not meet quality standards. Even if users have received training on the safe operation of their devices, it is difficult to avoid accidents if the device is defective. Hence, the Ministry of Food and Drug Safety should establish standards of quality for the manufacture of electronic assistive devices, including criteria for quality measurement and enhanced permissions management.

Ⅴ. Conclusion

The findings have important implications that accident cases involving electronic assistive devices were investigated to determine how accidents can be avoided, and to devise instructions for preventative measures for the handicapped of these devices. The results of this study are limited in that they cannot represent all circumstances of handicapped who use electronic assistive devices. Furthermore, since the target areas of the survey were mainly confined to urban areas, the results do not represent the experiences of handicapped in rural areas. In future research, expanding the geographical area of the survey subjects will deliver more thorough results. Moreover, additional research is required to develop and verify the effectiveness of an accident prevention manual for people who use electronic assistive devices.

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