Impact of Living or Working Environments on Persons with Disabilities

Wei Liu

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UNESCAP Working Paper

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Abstract

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This paper assesses quantitatively the importance of living or working environmental constraints in people's activity limitations in day-to-day work/school and participation restrictions (such as joining in community activities). It applies an Ordered Logit Model to examine data from a WHO/ESCAP pilot study in 2005. Age, school year, and country specific factors are considered in this empirical analysis, with particular attention to gender. Environmental barriers have a negative and statistically significant influence on a person's life activities, after controlling for other determinants. Women and girls with disabilities in developing countries face double discrimination due to their status as a woman and a person with disabilities. The challenges for policy makers in the region are to identify these working or living environmental constraints, to formulate more targeted disability policies and to implement programmes in order to mitigate those barriers. Some areas needing additional research are also highlighted.

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1 Introduction

Persons with disabilities are often the most marginalized and vulnerable groups in the Asian and Pacific region, as they tend to face not only activity limitations but also working or living environmental and social barriers. These barriers include stigmatization, prejudice and discrimination[1], and a failure to modify work or living environments to make them fully accessible. All these negative conditions prevent them from freedom of movement in society, and act as a barrier against their full participation. People with disabilities often live in isolation, are insecure and thus have a lack of power, participation and respect, which is a major dimension of poverty (ESCAP *et al*, 2007). Many people do not want to reveal their genuine disability status in any data collections because they fear breaches of confidentiality, and subsequent stigma and discrimination. Lack of adequate and comparable data on persons with disabilities makes it difficult to enhance political will to identify problems, to develop effective programmes and to monitor their impact on disability issues. Hence, major concerns for policy makers are to find out who is disabled, what are their unmet needs, and which major factors contribute to their life or work activity limitations and participation restrictions.

Traditionally, disability was seen as a uni-dimensional, cause and effect process where the existence of some *disease* or *disorder* results in an *impairment* that is manifested physically at the body level.[2] This *impairment* inflicts an individual with a *personal disability* that *handicaps* him/her with respect to the rest of society. This approach on disability definition is also called the medical model of disability which asserts that impairment is nothing more than a consequence of disease conditions (WHO,

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[1] According to Convention on the Rights of Persons with Disabilities, Article 2, "Discrimination on the basis of disability" means any distinction, exclusion or restriction on the basis of disability which has the purpose or effect of impairing or nullifying the recognition, enjoyment or exercise, on an equal basis with others, of all human rights and fundamental freedoms in the political, economic, social, cultural, civil or any other field. It includes all forms of discrimination, including denial of reasonable accommodation. Source: http://www.un.org/disabilities/convention/

[2] See, for instance, WHO and ESCAP (2006), p.8, '*What is Disability Statistics*'; and Altman, (2001).

1980; WHO, 2001). This uni-dimensional model does not capture the causal connection that *handicap* (e.g. social exclusion) may lead to the creation of disability and impairment (Eide and Loeb, 2006). In particular, traditional approach ignores the impact of environmental factors on person's activity limitations and participation restrictions (Schneider *et al*, 2003).

In contrast, the new approach of disability definition, promoted by the International Classification of Functioning, Disability and Health (ICF),[3] was more focused on the close connection between the limitations experienced by persons with disabilities, the design and structure of their environments and the attitude of the general public. Environmental factors "make up the physical, social and attitudinal environment in which people live and conduct their lives (WHO 2001:10)". They can have the effect of *improving* or *hindering* an individual's body function, ability to execute an activity, and/or their participation in society (Loeb and Eide, 2006).

In the light of different approaches, this paper uses the existing conceptual model to organize an analytical framework of the environment-disability nexus and then assess quantitatively the importance of the environmental constraints in disability. In this study, I use two indicators to proxy general 'environmental constraints'. The first indicator, *Environment*, measures the degree to which the individuals face or experience barriers or hindrances. The second indicator, *Attitudes*, measures negative attitudes and actions of others to indicate the extent to which overall attitudes or culture act as a barrier.[4] What distinguishes this paper from other works in this broad area is that I pay particular attention to the following question:

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[3] The ICF is both a classification and a model of the complete experience of disability. As a classification, ICF provides an internationally recognised and uses common language. As a model of disability, the ICF offers a conceptual framework for structuring disability data.

[4] For the two questions using to measure environment constraints, see Appendix A, Question D6.2 and Question D6.3. Of course, there are limitations of these two indicators measuring general environmental barriers. To have better understanding of correlation between person's experience of disability and environmental factors, more detailed information on environmental barriers and facilitators that have an impact on a person's functioning are needed. Nevertheless, the selected two indicators are only environmental indicators available in the dataset.

Are different degrees of hindrances or barriers significantly associated with differences in an individual's ability to execute a task or an action?

In addition, two more research questions were taken into account while addressing the first one.

i) The extent to which environmental constraints are likely to influence people's disability status across countries.

ii) The extent to which gender factors influence on the results pattern. In combination with the previous analysis, this will allow us to quantify impacts of environmental factors on women with disabilities by comparing data from women with the general population.

To address those questions and to highlight areas in acute need of additional research, this paper is organized in the following way: Section 2 explains the conceptual model and what role environmental constraints can play in functioning and disabilities. Section 3 describes the Ordered Logit Model that is applied into this empirical study. Section 4 presents the data on the pilot study survey in five Asia and the Pacific countries. Section 5 discusses the possible theoretical linkages between environmental constraints and person's experience of disabilities, and examines the empirical evidence and its policy implications. Section 6 concludes.

2 Environment in the ICF Model

Environmental factors are an important component of the ICF model. It is reasonable to assume that the working and living environment can be adjusted relatively quickly through formulating disability policies and implementing programmes, while the person's functioning status can hardly change in the short term unless he or she takes

a rehabilitation programme. Thus, identifying environmental barriers and facilitators tend to be more relevant to policy that promotes an inclusive, barrier-free and rights-based society for persons with disabilities rather than simply identifying functioning problems of individuals and counting how many persons there are with vision difficulties, or hearing problems etc. Disability in the ICF model is viewed as a dynamic process and characterized partly as the result of an interaction between persons with disabilities and his/her particular environment. Therefore, understanding the impact of school, working and living environments on disabled people will contribute to a better assessment of the process of equalizing opportunities for persons with disabilities.

According to the ICF model, the environmental factors focus on two different levels (United Nations, 2001, p.87):

1. Individual: in the immediate environment of the individual, including but not limited to settings such as home, workplace and school. It includes the physical and material features of the environment that an individual comes face-to-face with as well as direct personal contact with others such as family, acquaintances, peers and strangers.

2. Services and systems: the formal and informal social structures, services and over-arching approaches or systems in the community or a culture that have an impact on individuals. These structures or systems include organizations and services related to the work environment, community activities, government agencies, communication and transportation services, and informal social networks as well as laws, regulations, and formal and informal rules, attitudes and ideologies.

As stated in Hendershot (2006), one of the main developments in the ICF over its predecessor, ICIDH, is the recognition of environmental factors as major determinants of all three dimensions of functioning and disabilities,[5] especially of participation (see

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[5] These three dimensions of functioning and disability are 1) body functions and structures, 2) activities, and 3) participation.

Figure: Interaction between the components of ICF, WHO 2001, p.26). This expansion takes into account not only what the individual brings to the interaction but also what the environment brings to it, which can capture not only a person's disabilities but also 'societal disability'. In particular, the notion of the interaction is part of this expansion and new perspectives in the ICF. When any element of the interaction changes, the whole outcome also changes.[6] Thus, disability is no longer a static and personal phenomenon but a result of interaction (WHO and ESCAP, 2006, p.30).

ICF Components of Environmental Factors have been classified into the following five domains:[7]

- Products and technology, e.g. products and technology for communication design, construction and building products and technology of buildings for public use;

- Natural environment and man-made changes to environment, e.g. physical geography, light, sound, air quality;

- Services, systems and policies, e.g. social security services, systems and policies;

- Support and relationships, e.g. immediate family, health professionals; and

- Attitudes, e.g. individual attitude of friends and health professionals.

In addition, environmental factors include educational and informational environment, e.g. unavailability of subtitles, lack of standardized sign language taught at schools and used on the Internet. All these factors can serve as either barriers or facilitators. Because of the interaction between the activity limitations and the environment a person faces, disability is modelled as a dynamic process in which a person's status can change over time. It is crucial to emphasize that the problems or difficulties a

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[6]The author thanks for Marguerite Schneider's helpful comments here.
[7]See WHO (2001) outlined by Madden (2006).

person experiences may differ conditionally on his or her environment. Loeb and Eide (2006, p.119-20) provide an excellent example to illustrate this point:

> "A young boy lost the use of his legs in an automobile accident 25 years ago. He has been confined (using) to a wheelchair since being discharged from the hospital. Today he is an active member of society, working and supporting a family. Because he is dependent on the wheelchair, his scores on certain elements in the matrix will be high: he cannot move about (around) easily without assistance. At the same time this person has become accustomed to life in a wheelchair, and in his current environment he is able to get around with little hindrance - he will score lower[8] on the scale of participation restrictions."

An environment with facilitators can improve the experience of persons with disabilities in participation in a society; one with barriers, or without facilitators, will restrict their integration. Different degrees of barriers or negative attitudes, therefore, may have different impacts on the same individual with a given health condition. For example, having access to technical aids, health care or medical treatment, or physical adaptation to the environment may allow individuals to overcome their disabling conditions. This process can be named as "disability reduction". Ideally, similar to the poverty lines, countries will have "national disability line" for formulating national policies and " '$1-a-day' disability line" for international comparisons. Nevertheless, disability is far more difficult to be defined and measured than monetary poverty due to complications of cultural and linguistic diversity, and sensitive topics dealing with personal health and disabilities. Collecting and analyzing disability data by taking into account environmental factors is still at the experimental stage in many developing countries.

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[8] Please note that 'score lower' means less difficulty.

Eide and Loeb (2006) have recently used environmental questions from *Craig Hospital Inventory of Environmental Factors* in their research project on living conditions among persons with activity limitations in Zambia, a study which provides a good example on how to capture the information on environments (see Appendix A). Rasch, Altman and Madans (2006) have discussed various methodological issues in disability including the function of assistive device use and cultural practices that influence the nature of the environment or limited participation. Moreover, Madden (2006) has reviewed how to put ICF concepts into practice, in particular on recording environmental factors (such as personal assistance, equipment, environmental modifications). In light of the theoretical development as well as testing, Australian Bureau of Statistics has made considerable efforts to design a census question set on 'need for assistance', or now termed: 'core activity support needs' for inclusion in the 2006 Australian National Population Census (see WHO and ESCAP, 2006, for the question set).[9] More theorists, statisticians and researchers have attempted to illuminate more precisely the tie between environment factors and disability (see, for instance, Altman and Barnartt (ed.), 2006; Schneider *et al*, 2003; and Altman *et al* (ed.), 2001). However, few studies have examined the empirical evidence on the relationship between environment and disability across countries, partially due to limitations of relevant data. This paper fills the gap by linking together the conceptual understanding and empirical examination, benefiting mainly from recent data collection of pilot studies in Asia and the Pacific.

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[9]For details of testing a disability question for the Australian census, see Black (2006).

3 Methodology: Ordered Logit Model

This paper uses the Ordered Logit Model to study the factors that influence disability severity. It is necessary to clarify what is meant by 'disability severity' before moving on to describe the Model. Based on the ICF approach, this paper studies the disability phenomenon through an assessment of an individual's activity limitations and participation restrictions.[10] The two items used in this study to proxy disability - going to work/school and participating in community - are both complex activities. The person's execution of these activities (measured as capacity) is determined by more basic activities such as seeing, hearing and mobility difficulties. Nevertheless, the person's involvement in these two life activities (measured as performance) is determined by what the individual brings to the interaction of his or her health condition with the context of the person. This is measured as the external environmental factors for the purpose of this paper. The way the two questions (for the two disability indicators) were asked did not specify whether they are measuring capacity or performance. The issues of capacity vs. performance and/or basic vs. complex activities are being debated and there is no common understanding of these among ICF users. This study and its data used allow us to investigate the outcome of the interaction of the person with a health condition and the environmental factors. Consequently, 'disability severity', in this paper, represents an individual's performance rather than capacity.

The general form of the Ordered Logit Model can be explained via equations (1) through (7).[11] Let Y_i denotes an individual's observed disability severity level which is reported by the respondents, Y_i^* the latent (unobserved) disability severity measure, and θ_j $(j = 1, 2, 3, 4)$ the thresholds for disability severity. A person can, for example,

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[10]By using this rights-based approach of definition, it will be easy to establish the linkages between disability and poverty. According to the recent book, *Inequality, Poverty and Well-being (2006)*, edited by Mark McGillivray, poverty consists of a lack of power, participation and respect, which is in line with disability definition here. For the sake of limiting the scope of this study, I didn't discuss the issues on disability, poverty and development.

[11]Also see Borooah (2001) and Menard (2002).

be classified as having "No difficulty", "Mild difficulty", "Moderate difficulty", "Severe difficulty" and "Extreme/cannot do" - and a variable Y_i can be associated with these disability severity levels, such that $Y_i = 1$ if a person has no difficulty in his or her day-to-day work/school, $Y_i = 2$ if a person has mild difficulty in his or her day-to-day work or school, and so on. In this case, Y_i is an ordinal variable, which means that the outcome associated with a higher value of the variable Y_i is ranked higher than the outcome associated with a lower value of the variable.

Thus, in the ordered logit model, there is an observed ordinal variable Y_i. And Y_i, in turn, is a function of another variable, Y_i^*, that is latent and not measured, such that the following holds:

$$
\begin{cases}
Y_i = 1 \text{ (no difficulty)}, & if \ \ Y_i^* \leq \theta_1 \\
Y_i = 2 \text{ (mild)}, & if \ \ \theta_1 \leq Y_i^* \leq \theta_2 \\
Y_i = 3 \text{ (moderate)}, & if \ \ \theta_2 \leq Y_i^* \leq \theta_3 \\
Y_i = 4 \text{ (severe)}, & if \ \ \theta_3 \leq Y_i^* \leq \theta_4 \\
Y_i = 5 \text{ (extreme)}, & if \ \ Y_i^* \geq \theta_4
\end{cases}
\tag{1}
$$

The latent disability severity measure Y_i^* is obtained using a linear equation:

$$
Y_i^* = \sum_{m=1}^{M} \beta_m X_{im} + \varepsilon_i = K_i + \varepsilon_i
\tag{2}
$$

where Y_i^* is a function of M factors ("determining variables") whose values, for individual i, are X_{im}, $m = 1, ..., M$. β_m is the coefficient associated with the mth variable $(m = 1, ..., M)$ and $K_i = \sum_{m=1}^{M} \beta_m X_{im}$. Examples of such factors X_{im} might include having vision, hearing or mobility difficulty. Note that there is a random disturbance term ε_i, which, in this case, has a logistic distribution. The error term reflects the fact that relevant variables may be left out of the equation, or variables

may not be perfectly measured.

If one defines $\theta_{-1} = -\infty$, $\theta_0 = 0$, $\theta_j = +\infty$, then the probability of disability severity j for the ith observation can be written as the following:

$$\Pr\left(Y_i = k \mid X\right) = \Pr\left(\theta_{j-1} \le Y_i^* \le \theta_j\right) = F\left(\frac{\theta_j - \beta_m X_{mi}}{\sigma_i}\right) - F\left(\frac{\theta_{j-1} - \beta_m X_{mi}}{\sigma_i}\right) \tag{3}$$

The probabilities of observed variable Y_i taking values k, where $k = 1$, 2, 3, 4 or 5, are given by the continuous latent variable Y_i^* having crossed a particular threshold. For example, it might be that if the unobserved latent variable Y_i^* was 5.77 or less, the score on Y_i would be 1; if the unobserved latent variable Y_i^* was between 5.77 and 7.43, Y_i would equal 2. $F\left(\cdot\right)$ is the logistic distribution with cumulative distribution function (CDF) and σ_i^2 is the variance of the random contribution of unobserved factors in the ith observation, parameterized so as to ensure its positivity, by using an exponential function. In other words, $F\left(\cdot\right)$ is expressed as:

$$F(X) = \left(1 + \exp\left(-X\right)\right)^{-1} \tag{4}$$

and σ_i^2 can be written as:

$$\sigma_i^2 = \left(\exp\left(\gamma Z_i\right)\right)^2 \tag{5}$$

where Z_i is the set of variables explaining the error term variance of the ith observation, and γ is the associated parameter set. The "threshold" values θ_1 to θ_4 of Eq 1 are unknown parameters to be estimated along with the β_m of Eq 2. The parameters of the model can be estimated using the method of maximum likelihood technique. The goal of maximum likelihood estimation is to find estimates of β_m and cutoff points θ_j that maximize the joint probability of obtaining the observed values.

Because observations are independent, their joint probability can be obtained from the product of marginal probabilities. The probability of observing $Y_i = k$ is the difference between the cumulative probabilities:

$$\Pr(Y_i = k \mid X) = \Pr(Y_i \leq k \mid X) - \Pr(Y_i \leq k - 1 \mid X) \tag{6}$$

The contribution to the likelihood for the ith observation depends on which value of k is observed. For the latent variable model, the parameters are estimated by maximizing the log-likelihood, given by

$$\log L = \sum_{j=1}^{J} \sum_{i=1}^{I} D_{ji} \log \left[F(\theta_j - \beta_m X_{mi}) - F(\theta_{j-1} - \beta_m X_{mi}) \right] \tag{7}$$

where $D_{ji} = 1$ if $Y_i = k$, 0 otherwise. Thus, the D_{ji} defines a set of K dummy variables, only one of which is equal to 1 for any observation.

As Greene (2003) indicates, in an ordered probit (or logit) model, the sign of any parameter β_m can only clearly determine the marginal effect of variable X_{mi} on the extreme probabilities (in this case, the probability of "No difficulty" and the probability of "Extreme difficulty/cannot do"). The marginal effects on all other probabilities are ambiguous, since a shift in the distribution can cause the probability of intermediate response types to fall or rise, depending on the positioning of the average response. Therefore, Tables 3 and 4 in Section 5.3 only present the marginal effects on two extreme probabilities: "No difficulty" and "Extreme difficulty".

4 Data

The data used in this paper comes from the pilot study survey jointly conducted by the World Health Organization (WHO) and the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) in 2005 (hereafter the Data).[12] This Data contains only cross-sectional units (countries) but no time periods.
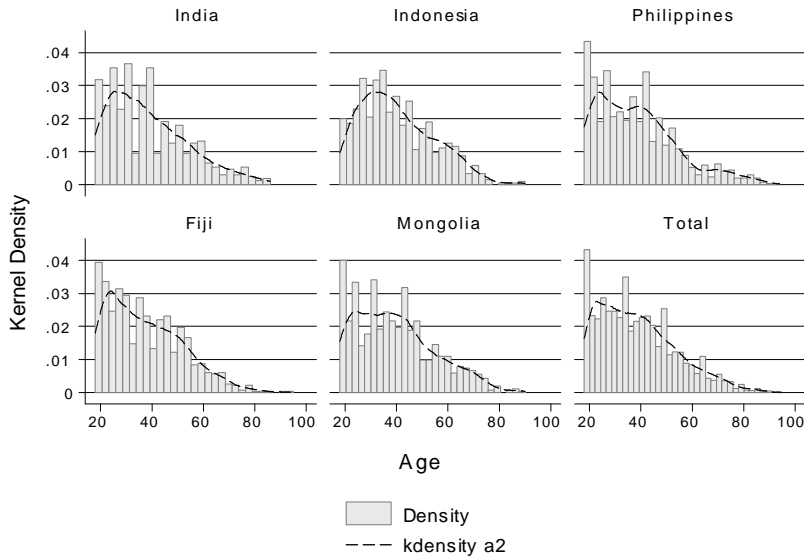
The pilot studies were carried out on samples of around 1,000 respondents per country aged 18 years or older in 5 countries: Fiji, India, Indonesia, Mongolia, and the Philippines. The questionnaire employed in all five studies included the Washington Group's recommended short set of questions,[13] WHO questions from the World Health Survey and WHO DASII, and Australian Bureau of Statistics recommendations for the need for assistance questions. Due to resource constraints in terms of time and funds at the time, the pilot study could not verify representativeness of the samples to the general population. Samples were mostly selected in limited locations, e.g. in capital cities only, taking into account the diversity in occupations, age, gender and income levels.

It is important to note that the Data is not totally unbiased. In some countries, samples were selected on the basis of expected high incidence of disability. Therefore, more cases on disability are likely to be presented in the Data. Moreover, different countries may vary in the quality of data due to factors such as quality of interviewer trainings, translation, etc. This causes some geographic heterogeneity in the Data. However, a pooled regression model assumes common coefficients across the cross-section units. Country-dummy variables are constructed in order to account for those

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[12]See the full questionnaire of the pilot study with question codes in WHO and ESCAP (2006) *Disability Statistics Training Manual*, Bangkok, which is available at: http://www.unescap.org/stat/meet/widsm4/index.asp. The questionnaire can also be obtained upon request to the author.

[13]The Washington Group on Disability Statistics was formed as a result of the United Nations International Seminar on Measurement of Disability in 2001. It is an expert group to address the issues related to disability measurement. For details, see Altman (2006).

India   Indonesia   Philippines

Fiji   Mongolia   Total

Kernel Density

Age

Density
--- kdensity a2

Graphs by country names

Figure 1: Kernel Density Distribution of Age

biases and country heterogeneity.

Despite the above mentioned sample limitations, among all available data sets, this Data could be the most appropriate one for this study because of its detailed information (larger set of questions based on WHO DAS are provided for comparison to the core questions), comparatively more systematic and comprehensive approach of data collection (more training and detailed guidance on translation etc), and relative large sample size.

Figure 1 illustrates the Kernel Density distribution of age by countries of the Data. The Philippines and Mongolia have similar age distribution; while the statistics for India and Fiji are close as well. Indonesia has relatively fewer people in their 20s. In regression analysis, country dummy of Indonesia is dropped in order to avoid a singular matrix.

In addition to detailed information concerning the individual's disability status, one question in the pilot studies refers particularly to a person's life activity limitations

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involved in household and work or school related activities *due to health problems.* The question is the following: *"due to health problems,* how much difficulty did you have in your day-to-day work/school"? The code of this question in the questionnaire is D5.5. Answers vary from 1 to 5, corresponding to increasing difficulty being reported. Category 1 corresponds to the "None" of difficulty; category 2 corresponds to "Mild"; category 3 is "Moderate"; category 4 is "Severe"; and category 5 is "Extreme/cannot do".

A question on individual's participation in society could also be a dependent variable. The question chosen for our estimation is the following: *"due to health problems,* how much of a problem did you have joining in community activities (for example, festivities, religious or other activities) in the same way as anyone else can"? The code of this question in the questionnaire is D5.6. The response categories are the same as Question D5.5. The summarized data indicates that more than 80 per cent of the total sample choose 'No difficulty' in both of the two questions.

Due to the reason explained in the previous section, in this study, I use "Life Activity Limitations" (D5.5) and "Community Participation Restrictions" (D6.1) as the dependent variables to proxy 'disability severity' separately.

5   Evidence

5.1   Regression Model

Are different degrees of barriers or negative attitudes significantly associated with differences in an individual's ability to execute a task or an action? To assess the nature of the environment-(dis)ability relationship, I first describe the regression model that highlights linkages and measurement issues. Then, I examine existing evidence from the

five countries on the relationship. Specifically, this study addresses how environmental factors facilitate or hinder the individual's participation and activity.

One feature of this study is that it systematically controls other factors influencing disability. To explore the linkage between functioning and disability, I estimate the following empirical model by using the Data in 2005:

$$
\left[
\begin{array}{c}
Disability_i^* = \alpha_1 + \beta_1 \cdot Environment + \beta_2 \cdot Functioning + \beta_3 \cdot Gender \\
+ \beta_4 \cdot Age + \beta_5 \cdot Age^2 + \beta_6 \cdot School + CountryDummy + \varepsilon_i
\end{array}
\right] \tag{8}
$$

The latent variable $Disability_i^*$ is determined by Equation (8). $Disability_i$ can be observed through Question D5.5 (school/work limitations) or Question D6.1 (community participation restrictions). ICF defined *activity limitations* as difficulties an individual may have in executing actions, and *community participation restrictions* as problems an individual may experience in life situations. The extent of the problem is denoted using the following scale: 1 "No problem", 2 "Mild problem", 3 "Moderate problem", 4 "Severe problem", 5 "Complete problem", 8 "Not specified", and 9 "Not applicable" (note that I consider 8 or 9 answers as missing data in the regression analysis). Given that 'disability severity' - $Disability_i$ - is a dependent variable with a natural order (see Equation 1), I apply the ordered logit model to estimate the regression (8) through maximum likelihood. The determining variables used to "explain" a person's 'disability severity' level were given by:

- *Environmental factors*
- *Functioning*, including:

    Seeing difficulty
    Hearing difficulty
    Mobility difficulty
    Cognation difficulty (in remembering or concentrating)

Self-care difficulty (e.g. washing whole body or dressing)

Communication difficulty

In this study, I use two indicators to proxy 'environmental factors'. The first indicator, *Environment*, measures the degree to which the individuals face or experience barriers or hindrances. The question code in the pilot test questionnaire is D6.2 (barriers or hindrances, see Appendix). The intuition underlying this measure is that it can capture general environmental barriers of individuals. The second indicator, *Attitudes*, measures negative attitudes and actions of others to indicate the extent to which overall attitudes or culture act as a barrier. The question code is D6.3 (attitudes and actions of others, see Appendix). I also use a short set of indicators proposed by the Washington Group on disability statistics as control variables on individual's functioning limitations. *Functioning* represents a vector of conditioning information to control for other factors associated with disabilities (e.g. difficulty in seeing, hearing, mobility, cognation, self-care, and communication). These are basic activities of individuals.

In addition to these variables, it was possible that the level of activity limitations or participation restrictions might depend upon his or her total years of schooling because persons with less education are in a relatively disadvantaged group. This also applies to the person's gender since often women with disabilities in developing countries face double discrimination due to their status as women and persons with disabilities. To account for these factors, two other controlled variables were considered:

- *Gender*, and

- *School*.[14]

In the model specification, the age factor is important in this context of estimation as well. The squared value of the age variable (Age^2 above) introduces a nonlinearity

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[14]To measure the 'school years', the following question was used: "how many years in all did you spend studying in school, college or university?"

to the age effect: the marginal effect of an increase in age upon $Disability_i$ depends upon the age from which the increase takes place. If $\beta_4 > 0$ and $\beta_5 < 0$, then age is closely and positively associated with disabilities. These are factors that could influence disabilities besides environment and functioning factors. *Gender*, *Age*, *School*, and *Country Dummies* could be relevant factors. I controlled all these factors by including them into the regression model for the robustness of estimated results on impacts of environmental factors and focus attention on the variables which really matter.

5.2   Results

There is a strong positive relationship between each of the two environmental barrier indicators, and the selected disability indicators: $Disability_j$ - difficulties in school or work limitations and community participation restrictions. This is in line with the conclusion of Schneider *et al* (2003).[15]

Table 1 summarizes the results for the coefficients on environment and attitudes. Not only are *all* the coefficients of the environmental factors statistically significant (large z values and small p values), but the sizes of the coefficients imply, at least partially, an important relationship. The regressions indicate that after taking into account the environmental factors, the following functioning and activity limitations lost statistical significance to explain 'disability':

- Hearing, and
- Communication.

Contrary to intuitions, the *Communication* coefficient even has the 'wrong' sign (contrary to intuition) which implies it may fail to capture the 'true' picture of an

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[15]Using different approaches, Schneider et al in their 2003 paper also underscored the central role played by environmental factors on a comprehensive and detailed description of a person's experience of disability.

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individual's communication problems. It is likely that *Hearing* and *Communication* are highly correlated. Including both of these two factors as explanatory variables in the regression may cause co-linearity problems. However, dropping one of them and re-running the regressions did not change the result patterns reported in Table 1.

Women with disabilities are often more vulnerable than men as they tend to receive less health care, to have fewer opportunities for education and employment, and to grow up lacking a sense of self-worth and self-esteem. Furthermore, they are denied access to the roles of women in their communities. Takamine (2003) quoted a study by ESCAP that the difficulties faced by girls with disabilities can start at birth and that if girls with disabilities are allowed to survive they can face discrimination within the family, receive less care and food and be left out of family interactions and activities. It is critically important to understand the issues of women with disabilities and to design and implement programs which address the needs of them. The sex-disaggregated data used in this study allow us to assess the extent to which the influence of gender factors on the results pattern and how environmental factors influence women and population differently in combination with the previous analysis.

Table 2 summarizes the regression results on women with disabilities. I use the same regression model to estimate disability as Table 1 suggested, but I only analyze the data reported by women. The results from Table 2 indicate that the impacts of environmental barriers become stronger in the women's group than in the whole population. For example, the coefficient of *Environment* in *Participation* regression model increases from 1.175 (Table 1) to 1.255 (Table 2) by introducing a woman's factor into the model. It is also interesting to find that the impact of negative *Attitudes* is smaller in the women's group compared with the whole population. This is not completely unexpected as women with disabilities may have become accustomed to life in a world that projects negative attitudes towards them. In other words, men often have stronger feeling on negative attitudes towards disabilities than women.

These results in Table 2, plus those from Table 1, suggest that there is significant evidence that environmental factors are good predictors of disabilities in terms of an individual's school/work limitations and community participation restrictions.

Table 1: Environmental Factors and Disability

	(1)		(2)	
	Activity (D5.5)		Participation(D6.1)	
Environment	0.556	(0.000)	1.175	(0.000)
Attitudes	0.683	(0.000)	0.542	(0.000)
Seeing	0.254	(0.010)	0.172	(0.043)
Hearing	0.174	(0.270)	0.128	(0.327)
Mobility	0.775	(0.000)	0.537	(0.000)
Cognition	0.503	(0.000)	0.236	(0.010)
Self-care	0.567	(0.001)	0.443	(0.001)
Communication	-0.0574	(0.700)	0.203	(0.074)
Sex	-0.0715	(0.489)	0.0901	(0.329)
Age	0.0338	(0.049)	-0.0141	(0.326)
Age squared	-0.000382	(0.048)	0.000132	(0.402)
Education	-0.0142	(0.286)	0.0190	(0.121)
Country Dummy				
Observations	3161		4295	
Pseudo R^2	0.223		0.264	
AIC	3380.9		4341.6	
BIC	3502.1		4468.9	

p-values in parentheses

Note: dependent var is Activity Limitations or Participation Restrictions.

5.3 Marginal Effects

Note that the coefficients reported in Tables 1 and 2 cannot determine the sizes of the marginal effects on the dependent variables by using non-linear ordered logit model (see explanations in Section 3). However, Tables 3 and 4 provide this analysis. Please note that gender, age, school year and country specific factors were controlled, although the estimated coefficients of these factors were not reported in Tables 3 and 4.

The first finding is that the marginal effects of environmental barriers are larger on 'No difficulty' outcome than on 'Severe' outcome. All the values in the 'No difficulty'

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Table 2: Environmental Factors and Women with Disability

	(1)		(2)	
	Activity (D5.5)		Participation(D6.1)	
Environment	0.578	(0.000)	1.255	(0.000)
Attitudes	0.586	(0.000)	0.441	(0.000)
Seeing	0.235	(0.093)	0.169	(0.127)
Hearing	-0.0579	(0.809)	0.166	(0.321)
Mobility	0.730	(0.000)	0.553	(0.000)
Cognition	0.665	(0.000)	0.217	(0.056)
Self-care	0.239	(0.297)	0.271	(0.125)
Communication	0.0708	(0.719)	0.154	(0.285)
Age	0.0147	(0.523)	0.000776	(0.967)
Age squared	-0.000128	(0.615)	0.0000156	(0.938)
Education	-0.00813	(0.654)	0.0232	(0.153)
Country Dummy				
Observations	1455		2319	
Pseudo R^2	0.228		0.259	
AIC	1695.3		2475.9	
BIC	1795.6		2585.1	

p-values in parentheses

Note: dependent var is Activity Limitations or Participation Restriction.

columns are much larger than the values in the 'Severe difficulty' columns (Tables 3 & 4). This means that changes in environmental barriers (including negative attitudes) will have a stronger impact on the change of likelihood from mild difficulty to no difficulty, but a weaker impact on the change of likelihood from moderate difficulty to severe difficulty.

A second implication is that all the coefficients of the estimated model have the 'correct' (intuitive) signs. The marginal effects on the probability of "No difficulty" have opposite signs of the coefficients on the left hand side of Tables 3 and 4, while the probability of persons with "Severe difficulty" has the same signs. The 'nicer' environment is consistently and negatively related to a person's experience on school/work limitations and community participation restrictions. For instance, Table 3 indicates that the probability of observing the outcome 'No difficulty' in day-to-day work or school will increase **6.6 per cent** in the event that a person's experience of environ-

mental barriers are reduced by a marginal unit. This effect was even stronger in Table 4, *ceteris paribus*, if Group A reported 1 unit less environmental barrier than Group B experienced, then the probability of Group A being observed as 'No difficulty' in joining in community rather than 'Mild difficulty' will be **13.4 per cent** higher than Group B. Estimation results suggest that a significantly decreased presence of 'disability' and an increased power, participation and respect are associated with a lower effect of environmental barriers. In other words, a one unit standard deviation improvement in environment would downgrade severe disability status and decrease the probability of a person experiencing a mild disability by more than 13 per cent. This finding has important policy implications. In particular, it reflects the possible magnitude of the impacts of 'barrier-free' social policy. The effective barrier-free policy could essentially lift 13.4 per cent of people from mild disability to no disability according to the sample at hand.

It should be kept in mind that conclusions emerging from this cross-country analysis must be interpreted with care. For example, in practice, it is difficult to measure the effectiveness of barrier-free policy and to quantify 'a one standard deviation improvement in environment'. This paper does not analyze the 'real' changes made by national disability practices on improvement of environment and 'disability reduction'. Nevertheless, this study estimates that among all these factors specified in Equation (8), the relative importance of environmental factors in general and the likelihood of quantitative effects of benign social environments.

The third finding is that indicators on functioning limitations and basic life activities are strongly correlated with functioning indicators, especially *mobility*, *cognition* and *self-care* indicators. It is worth remarking that mobility difficulty has the largest marginal effects on an individual's difficulty in day-to-day work or at school (see Table 3). This result was also found in a previous study (see Smit and Liu, 2007) which underlined the importance of the barrier-free social policies.

Table 3: Marginal Effects on School/Work Limitations

	(1)		(2)	
	No Difficulty		Severe	
Activity limSchWork				
Environment	-0.0664	(0.000)	0.00268	(0.000)
Attitudes	-0.0816	(0.000)	0.00329	(0.000)
Seeing	-0.0303	(0.010)	0.00122	(0.017)
Hearing	-0.0208	(0.271)	0.000840	(0.276)
Mobility	-0.0926	(0.000)	0.00374	(0.000)
Cognition	-0.0601	(0.000)	0.00243	(0.000)
Self-care	-0.0677	(0.001)	0.00273	(0.004)
Communication	0.00685	(0.700)	-0.000277	(0.700)
Observations	3161		3161	
Pseudo R^2	0.223		0.223	
AIC	3380.9		3380.9	
BIC	3502.1		3502.1	

Marginal effects; p-values in parentheses

(d) for discrete change of dummy variable from 0 to 1

Note: dependent var is difficulty level in day to day work/school

Table 4: Marginal Effects on Participation Restrictions

	(1)		(2)	
	No Difficulty		Severe	
Join in Community				
Environment	-0.134	(0.000)	0.00628	(0.000)
Attitudes	-0.0619	(0.000)	0.00290	(0.000)
Seeing	-0.0197	(0.043)	0.000921	(0.049)
Hearing	-0.0146	(0.328)	0.000683	(0.331)
Mobility	-0.0613	(0.000)	0.00287	(0.000)
Cognition	-0.0269	(0.010)	0.00126	(0.014)
Self-care	-0.0506	(0.001)	0.00237	(0.002)
Communication	-0.0231	(0.075)	0.00108	(0.082)
Observations	4295		4295	
Pseudo R^2	0.264		0.264	
AIC	4341.6		4341.6	
BIC	4468.9		4468.9	

Marginal effects; p-values in parentheses

(d) for discrete change of dummy variable from 0 to 1

Note: dependent var is difficulty level in joining in community activities

5.4 Policy Implications

The main results derived from the analyses presented in this paper are that environmental barriers both tangible and intangible play significantly negative roles on individual's ability to conduct their life activities. These barriers include the stigma of disability and discrimination. Women and girls with disabilities in developing countries face double barriers and discrimination due to their status as women and persons with disabilities. These results will be found statistically insignificant in a truly rights-based, barrier-free society. Through formulating disability policies and implementing programmes, governments, international agencies and NGOs can play a major role in mediating the needs and priorities of disabled people and mitigating barriers. This section links empirical findings to policy recommendations in the following two perspectives.

5.4.1 Mitigating Physical Barriers

People with disabilities can play an active role as contributors to the growth of national economies and to the welfare and diversity of societies, through appropriate rehabilitation and assistive technologies, disability-sensitive architectural design, empowerment and affirmative strategies and inclusion. Policy makers shall formulate, implement, monitor and evaluate policies and programmes which comply with global, regional and national laws and mandates. In terms of global legislation, the United Nations Convention on the Rights of Persons with Disabilities (the Convention),[16] the first human rights treaty of the 21st century adopted by the General Assembly, mandates States Parties to take appropriate measures to ensure persons with disabilities access, on an equal basis with others, to the physical environment (Article 9). In terms of regional mandates, ESCAP adopted the resolution "Promoting an inclusive, barrier-free and

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[16] For the details of the Convention on the Rights of Persons with Disabilities, see http://www.un.org/disabilities/convention/

rights-based society for persons with disabilities in the Asian and Pacific region in the twenty-first century", and later adopted the "Biwako Millennium Framework for Action towards an Inclusive, Barrier-free and Rights-based Society for Persons with Disabilities in Asia and the Pacific (BMF)" as the regional policy guideline (ESCAP, 2002). In order to mitigate physical barriers, BMF encourages Governments and international agencies to

1. Adopt and enforce accessibility standards for planning of public facilities, infrastructure and transport, including those in rural/agricultural contexts;

2. Make existing public transport systems accessible as long as practicable;

3. Include universal and inclusive design concepts in international loan/grant criteria.

Therefore, policy makers should ratify and adopt international conventions, declarations, resolutions and recommendations concerning the rights of persons with disabilities; support and enforce the implementation of BMF and existing national legislation and policies;[17] and formulate, implement, monitor and evaluate barrier-free policies and projects.

5.4.2   Better Education, Better Attitude

Besides recommendations on man-made changes to the physical environment, the policy challenges for most countries are the ones that have to do with mitigating those intangible barriers, including educational, informational, institutional and attitudinal environments. They are all interconnected issues. Here I highlight education and disability policies and relate them to improvement of institutional and attitudinal environments.

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[17]For national disability-specific anti-discrimination laws, see *Disability at A Glance - A Profile of 28 Countries and Areas in Asia and the Pacific,* (ESCAP, 2006).

Education environment constraints, such as lack of standardized sign language taught at schools, would have been captured partially from regression variables "*Environment*" and "*Attitude*" in equation (8). Having identified these environmental barriers, it is difficult to ignore the message that persons with disabilities have greater special needs for educational services. Governments have assumed a substantial role in educating their citizens, including those with disabilities. However, according to a report recently released by ESCAP,[18] more than 90 per cent of children and youth with disabilities in Asia and the Pacific region have no access to any form of education.

What are the policy implications? Clearly, human capital can be built up by providing more schooling, but policies that fail to consider the special needs of persons with disabilities risk expanding the quantity of schools without truly "providing education for all", a central pillar of the Millennium Development Goals. More schooling translates into greater earnings and participation for individuals over their lifetime, which can develop persons with disabilities' self-confidence and enable them to become self-reliant. Moreover, a society with a more educated labour force can also expect faster economic growth even if the returns may not be discernible for many years. For those countries that invest in education to address special needs of disabled children and adults, investments have the potential to deliver economic as well as social gains. Showing their economic values, persons with disabilities will be more likely to live with dignity and benefit from *positive attitudes* of families and the society since they are not social and family burdens anymore.

Too often, there are no regular education programmes and policies for persons with disabilities enabling their participation in all aspects of social life. The educational programmes frequently ignore the special needs of disabled children, resulting in inadequate teacher training, inflexible curricula and assessment procedures, lack of appropriate teaching equipment and devices, and a failure to modify school environments

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[18]See ESCAP, UNDP and ADB (2007) "Access to Basic Services for the Poor: the Importance of Good Governance", page 13.

to make them fully accessible (ESCAP *et al*, 2007). This underscores the need to assess student environmental constraints. The key element is measuring their needs directly by using ICF approach. Without objective data about their true needs, programmes and policies often proceed in unproductive directions.

This analysis underscores the need for better public policies and data to reduce disabilities. What does it take to help persons with disabilities? Among other policy recommendations, spending more on education and disability information system effectively will help and enhance human capital for all. Governments should work more closely with civil society organizations to mitigate environmental barriers, and ensure that political processes are inclusive, thereby providing opportunities for persons with disabilities to participate in the decision-making process that directly affects their lives.

6   Concluding Remarks

This study finds that there are significant non-linear correlations among school/work limitations, community participation restrictions and environmental barrier indicators selected. The results also illustrate strong link between more visible and most prevalent basic activity limitations and those most susceptible to environmental barriers - especially physical and attitudinal barriers.

The evidence from the regression model and the marginal effect tests demonstrates important implications for assessment of an individual's activity limitations and community participation restrictions when the central role played by environmental factors is fully evaluated. Some conclusions can be drawn as follows.

First, disability questions should take into account **'core environmental factors'** such as environment barriers and attitudes in order to capture those with severe as well as less severe forms of disabling conditions. A 'full' picture of a person's disabilities cannot be recorded without describing the degree of hinderance or barriers experi-

enced. This study determines predictive validity by computing correlational coefficients comparing environmental factors, for example, activity limitations in day-to-day work/school. It will facilitate discussion on development of a 'core' set of questions. Note that the two environment questions have been used in this study are broad and often useful more at a broad monitoring of policies than for developing the disability programmes and policies - which need more specific information on barriers and facilitators. Depending on data needs, some countries could expand upon this core question set or limit its scope for specific data collection in order to better match their purposes.

Second, **'barrier-free'** social policy will benefit persons with disabilities, not only those with severe disability, but also with mild disability. A large proportion of persons with mild disability will be 'lifted' out of disability status if Governments effectively implement this kind of social policies.

As in any critique, I omit or treat cursorily important issues. Here I highlight two. First, this paper does not discuss the relations between environmental factors and an individual's functional limitations. On this note, for instance, additional studies are needed focusing on investigating more specific environmental factors and their relationship not only with questions dealing with broad life activities, but also with more basic and detailed life activities. Nevertheless, this paper narrows its conceptual focus by studying interactions between general measures of an individual's activity limitations or participation restrictions and environmental factors. Second, the paper does not conduct in-depth analysis on policy issues related to improvement of environment and 'disability reduction' using more country case studies. Given the links between the environment and disability, designing optimal environment policies and providing inclusive practices are critically important. A rigorous discussion of these policies and social projects, however, would require a long article or an entire book.

Additional studies and tests on inclusion of environmental factors should be planned and conducted, e.g., further analysis of 'core' domains on environmental factors

to select or reconsider the phrasing of the questions for the selected domains and to study 'extended' question sets for use in surveys.

In describing the conceptual and empirical links between environment and disability, I highlighted areas needing additional research. Two more areas are worth emphasizing. First, there is no sufficiently rigorous understanding of a number of core items on environmental factors that can be regarded as vital to any level of disability study. As Me and Mbogoni (2006) stated, the recognition of the role of the environment brings new challenges to the measurement of disability. In order to operationalize ICF's component on environment factors, the question design needs to be developed and tested in the field. The issue is not simply to count persons who are disabled. Through assessing environmental factors, policymakers and researchers intend to have a better understanding on: i) are persons with disabilities restricted in the level of or type of their educational attainment and employment compared to others? ii) has equalization of opportunity been on track or already achieved?

A second area requiring additional research involves more empirical analysis on the dynamic process of disabilities. A person's status can change over time; disability is a continuous phenomenon. Further analysis on the changes of degree of barriers experienced and its impacts will definitely be fruitful. Future research may improve our understanding of disability as the outcome of an interaction of persons with a health condition and the environmental factors. Time series data would be required for this additional research.

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A Appendix: Inventory of Environmental Factors — On the Way to Design a Questionnaire for Surveys

Interview instructions: please tell me how often each of the following has been a barrier to your own participation in the activities that matter to you. Think about the past year, and tell me whether each item on the list below has been a problem daily, weekly, monthly, less than monthly, or never. If the item occurs, then answer the question as to how big a problem the item is with regard to your participation in the activities that matter to you.

(Note: if a question asks specifically about school or work and you neither work nor attend school, check not applicable.) Think about the last 12 months only.

1. how often has the availability/accessibility of transportation been a problem for you?

2. how often has the natural environment - temperature, terrain, climate - made it difficult to do what you want or need to do?

3. how often have other aspects of your surroundings - lighting, noise, crowds, etc - made it difficult to do what you want or need to do?

4. how often has the information you wanted or needed not been available in a format you can use or understand?

5. how often has the availability of health care services and medical care been a problem for you?

6. how often did you need someone else's help in your home and could not get it easily?

7. how often did you need someone else's help at school or work and could not get it easily?

8. how often have other people's attitudes toward you been a problem at home?

9. how often have other people's attitudes toward you been a problem at school or work?

10. how often did you experience prejudice or discrimination?

11. how often did the policies and rules of businesses and organizations make problems for you?

12. how often did government programs and policies make it difficult to do what you want or need to do?

Qualifier for Environmental Factors:

1	Always
2	Often
3	Seasonal
4	Seldom
5	Never
8	N.A.
9	Barrier, not specified

Source: The Creation of the Craig Hospital Inventory of Environmental Factors (CHIEF) used in Arne H Eide and M. E. Loeb (eds.) (2006) *Living Conditions among People with Activity Limitations in Zambia - A National Representative Study.* SINTEF Health Research.

WHO DAS II Questions on *Environmental Factors*:

- How much of a problem did you have because of **barriers or hindrances** in the world around you? (D6.2)

- How much of a problem did you have **living with dignity** because of the attitudes and actions of others? (D6.3)
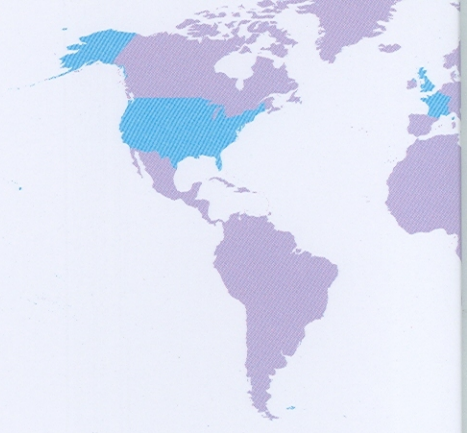
The Environmental Factor qualifier uses a negative scale to indicate the extent to which an Environmental Factor acts as a barrier.
Qualifier for Environmental Factors:

1	No barrier
2	Mild barrier
3	Moderate barrier
4	Severe barrier
5	Complete barrier
8	Barrier, not specified
9	Not applicable

Source: WHO and ESCAP (2006) *Disability Statistics Training Manual.*