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Happiness and Physical Activity in Special Populations: Evidence From Korean Survey Data

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Abstract

This article contributes to the literature on happiness by focusing on the effects of physical activity or sport participation on happiness or life satisfaction in a special population. Using survey data collected by the Korean Sports Association for the Disabled, all respondents were legally disabled. This study presents empirical evidence of positive "nonhealth effects" of physical activity on life satisfaction. Approximately a one-level jump in physical activity in the six-level score provided the same improvement in life satisfaction as one-quarter of the effect of the employment status change from unemployed to employed. Additionally, the empirical finding that the level of disability was insignificant in determining subjective well-being is consistent with a threshold argument. The authors' empirical results also support there being no adaptation to disability, in contrast to findings in the psychology literature.

Keywords

physical activity, sport participation, disability, subjective well-being

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Introduction

Recently, "happiness literature," which analyzes determinants of happiness or life satisfaction by using self-reported survey data, has accumulated. For example, Kahneman and Krueger (2006) pointed out a dramatic change in the number of research papers examining data on happiness during the last decade. The number was only 4 from 1991 to 1995 according to *EconLit*, but it was more than 100 during 2001-2005.

A major focus has been the relationship between income and happiness (Clark & Oswald, 1996; Easterlin, 1974, 1995; Graham & Pettinato, 2002; Kahneman, Krueger, Schkade, Schwarz, & Stone, 2004; Luttmer, 2005). The empirical results on this are somewhat mixed. Kahneman and colleagues (2004) examined the belief that high income was associated with good mood but found that the effect of income on life satisfaction seemed to be transient. Easterlin (1995) used data from macroeconomics and found that the average self-reported happiness level did not increase in Japan between 1958 and 1987, although real income increased rapidly. Luttmer (2005) and Graham and Pettinato (2002) emphasized the importance of relative income. Graham and Pettinato compared happiness in Latin America and Russia using panel data and showed that favorable relative income differences had strong positive effects on reported well-being based on data from both countries. Powdthavee (in press-a) also applied an ordered probit approach to the British household panel survey and found that income had a positive effect on happiness or life satisfaction.

Other determinants of happiness have been empirically examined. Winkelmann and Winkelmann (1998) estimated the nonpecuniary effects of unemployment. Oreopoulos (2003) found that years of education were positively associated with life satisfaction. Clark, Diener, Georgellis, and Lucas (2008) showed that life events, such as marriage and bereavement, have substantial effects on happiness and life satisfaction, but these effects were largely temporary. Powdthavee (in press-a) was interested in the link between social relationships and life satisfaction to estimate the value of a social relationship. He found a significant valuation. For example, an increase from "seeing friends and relatives once or twice a week" to "seeing friends and relatives on most days" was equivalent to a large increase in real household income of about £15,500 per capita.

Disability and health also have been investigated in connection with life satisfaction. Powdthavee (in press-a) showed that disability had a large negative valuation, and the cost of disability was estimated to be around £165,500. However, Oswald and Powdthavee (2008) found that average life satisfaction dropped after the onset of a moderate disability but partially recovered to the extent of 50%, after 3 years. In cases of severe disabilities, they found that adaptation was incomplete even after more than 6 years of disability in British longitudinal data. Smith, Langa, Kabeto, and Ubel (2005) also examined the adaptation issue and presented empirical evidence of partial adaptation to a new disability, with a great drop in life satisfaction and recovery of some of the predisability life satisfaction. Brickman, Coates, and Janoff-Bulman (1978) presented cross-sectional empirical evidence of adaptation that paraplegics were equally satisfied with life as able-bodied individuals. Evidence of a positive relationship also exists between health and happiness (Sales & House, 1971; Shedler, Mayman, & Manis, 1993).

In this article, we follow the line of happiness literature to analyze the determinants of happiness in a special (disabled) population empirically, with focus on the relationship between physical activity or sport participation and life satisfaction using Korean survey data. A great deal of empirical evidence from the health and exercise science literature indicates that physical activity improves both physical and mental health (Bassey, 2005; Blacklock, Rhodes, & Brown, 2007; Brown, Burton, & Rowan, 2007; Manson et al., 2002; Morrow, Jackson, Bazzarre, Milne, & Blair, 1999; Penedo & Dahn, 2005; Stone, 2004). A positive effect of physical activity on health has similarly been found in special populations with physical and/or mental disabilities. The general effects of physical activity include the prevention of cardiovascular diseases (Berlin & Colditz, 1990; Njoki, Frantz & Mpofu, 2007), reduced obesity (e.g., Chen, Henson, Jackson, & Richards, 2006; Macko et al., 1997), and enhanced motor abilities (Carmeli, Zinger-Vaknin, Morad, & Merrick, 2005). In particular, physical activity enhances mobility and reduces the level of disability (DL) in special populations (Kileff & Ashbum, 2005). Because improved health is closely associated with increased life satisfaction, we might expect a positive relationship between physical activity and life satisfaction.

However, this predicted relationship may not be clear in a special population. At least two arguments on this relationship have been proposed. One is that a minor enhancement in health would not influence life satisfaction, because the health status in a special population is always over some threshold. As Easterlin (1995) argued, once income levels are above a minimal absolute threshold, average satisfaction levels tended to be highly stable over time, even in the face of significant increase in income. The same logic may apply to this health issue. Once disabled and then being above some threshold of health, variation in life satisfaction may be insensitive to changes in health status. Alternatively, a positive relationship may exist between physical activity and life satisfaction. An improvement in health is not the only pipeline to connect physical activity to life satisfaction. Because average physical movement is expected to be less for the disabled than the able-bodied, physical activity itself may add to the utility of the disabled more than it would for the able-bodied. This would be a "nonhealth effect" of physical activity on life satisfaction.

Recent research conducted in Korea examined a cohort of 110,359 disabled people over the period 2000–2007 and found mixed results regarding the effect of performing regular exercise on health status. For middle-aged men, regular exercise significantly lowered the risk of diabetes, stroke, coronary heart disease, fracture/dislocation, arthritis, and depression/anxiety, regardless of the type of disability. However, for women, no significant result was found. Consistent results were found regarding the frequency of using medical services and personal medical expenditure.

For some diseases, the frequencies of using medical services (and hence medical expenditures) were smaller for the people who participated in regular exercise than those who did not. This was not evident for women (Park et al., 2008). However, according to Park et al. (2007, 2008), in which large data sets of the Korean National Health Insurance Corporation were analyzed, the reduction in medical expenditure for the special population was significantly smaller than for the able-bodied. The effect of physical activity was consistently positive in reducing the risk of having various diseases in the able-bodied (Park et al., 2007). Other than middle-aged men, however, the disabled sample showed inconsistent results regarding the effects of physical activity on health (Park et al., 2008). These results seem to support the aforementioned "threshold argument."

Therefore, this study would be placed in the growing literature on the economics of sport participation and the empirical analysis on the relationship between physical activity or sport participation and life satisfaction. This would be new in the literature even though there have been some attempts to analyze the effect of physical activity in the view of economic benefit. Most of these attempts estimated the economic benefit in terms of medical costs (Garrett, Brasure, Schmitz, Schultz, & Huber, 2004; Katzmarzyk, Gledhill, & Shephard, 2000; Tsuji et al., 2003; Wang, Pratt, Macera, Zheng, & Heath, 2004). Wang and Brown (2004) examined the medical costs due to depression, and found that 6.1% of the medical expenditure was inactivity associated, and this was about $429 in 2003 per capita.

This study estimated the happiness equation to analyze the nonhealth effects of physical activity or sport participation using cross-sectional survey data collected from a Korean sample of a special population. This article makes one of the first attempts to analyze not only determinants of happiness in a special population but also the relationship between physical activity and happiness. Moreover, it permits comparison of the effects of physical activity, measured by the frequency of participating in regular exercise and the intensity of exercise, quantitatively with those of income and unemployment, among others, on life satisfaction. The results of these analyses may imply indirect economic effects of participating in physical activity.

In the section on Data and Specification of the Happiness Equation of this article, we outline the survey data and the model specifications. We also discuss descriptive statistics and estimation methods. The estimation results are shown and discussed in the section on Estimation Results. Our conclusions round out the article in the Conclusion section.

Data and Specification of the Happiness Equation

Survey

The survey data used in this study were collected as part of a larger research project, the "medical, sociopsychological, and economic effects of participating in regular exercise for special populations" (Park et al., 2008), funded by the Korean Sports

Association for the Disabled. This survey was administered to over 600 randomly selected disabled individuals. Surveys with missing and unreliable values were excluded before statistical analyses. The survey included items asking about life satisfaction. One item was, "I am satisfied with my life," with seven possible responses from 1 (*very dissatisfied*) to 7 (*very satisfied*). This variable was used to express "happiness" in this study. Scales from a single question are considered to, perhaps, be less reliable than scales from multiple questions, because measurement errors tend to be larger on a single-item scale than the average of multiple-item scales (Powdthavee, in press-b). Thus, our survey included five questions on how one views one's state of well-being. These were (a) in most ways, my life is close to my ideal; (b) the conditions of my life are excellent; (c) I am satisfied with my life; (d) so far, I have gotten the important things I want in life; and (e) if I could live my life over, I would change almost nothing. These items were originally developed and validated by Diener, Emmons, Larsen, and Griffin (1985) and have been widely used to measure life satisfaction (Siedlecki, Tucker-Drob, Oishi, & Salthouse, 2008). Thus, this study used both measures of life satisfaction, a single-item measure and an average of multiple items, in the empirical examination as a robustness check.

Additionally, respondents were asked the following physical activity questions: "How often do you participate in physical exercise?" and "On average, how many minutes do you exercise per exercise session?" Other items asked about age, gender, education, marital status, employment status, average income, levels and types of disability, and self-efficacy–physical ability and self-efficacy–physical expression. The list of variables is shown in Table 1 with short descriptions.

The Happiness Equation and Estimation Method

This study followed a linear happiness function, as have previous studies. For example, Oswald and Powdthavee (2008), specified

$$LS_i = \alpha_0 + \beta_1 PA_i + \beta_2 Income_i + \beta_3 Z_i + \varepsilon_i, \quad (1)$$

where LS is the self-rated life satisfaction, PA is a variable representing frequency and intensity of physical activity, and Z is a vector of other variables affecting life satisfaction. Other variables include dummies for gender, employment status, marital status, education, and age. Z also nests characteristics of disability: level and duration of disability and dummies for types of disability.

As Table 1 shows, the range in possible response for the frequency of physical activity (PA1) is unevenly distributed, because the responses are 1 = *no exercise*, 2 = *once/month*, 3 = *1 ~ 2 times/week*, 4 = *3 ~ 4 times/week*, 5 = *5 ~ 6 times/week*, 6 = *everyday*. Therefore, we interpret the coefficient of PA1 as the average effect of a level jump of PA1 from all different levels on life satisfaction.

Table 1. Data Description

Variables		Descriptions
Life satisfaction (multiple)	LS1	Average of five life satisfaction item scores. 1 = *dissatisfied* ∼ 7 = *satisfied*
Life satisfaction (single)	LS2	Life satisfaction score, 1 = *dissatisfied* ∼ 7 = *satisfied*
Frequency of physical exercise	PA1	1= *no exercise*, 2 = *once/ month*, 3 = *1∼2 times/week*, 4 = *3∼4 times/week*, 5 = *5∼6 times/week*, 6 = *everyday*
Intensity of physical exercise	PA2	Duration of exercise in minutes per exercise
Income	Income	1 = *< $500*, 2 = *$500∼$1,000*, 3 = *$1,000∼$1,500*, 4 = *$1,500∼$2,000*, 5 = *$2,000∼$3,000*, 6 = *> $3,000*
Unemployed	UN	Employment status, 1 = *unemployed*, 0 = *employed*
Level of disability	DL	1 = *severe disability* ∼ 6 = *minor disability*
Duration of disability	DD	Duration of disability in years
Education	Edu	1 = *high school or lower*, 2 = *some college*, 3 = *bachelor's degree*, 4= *master's degree or higher*
Male	Male	1 = *male*, 0 = *female*
Married	Married	1 = *married*, 0 = *not married*
Age	Age	Age in years
Type 1 of disability	DT1	1 = *physical disability*, 0 = *other types of disability*
Type 2 of disability	DT2	1 = *brain lesion*, 0 = *other types of disability*
Type 3 of disability	DT3	1 = *visual impairment*, 0 = *other types of disability*
Type 4 of disability	DT4	1 = *hearing impairment*, 0 = *other types of disability*
Type 5 of disability	DT5	1 = *intellectual/emotional disorder*, 0 = *other types of disability*
Type 6 of disability	DT6	1 = *all other disability*, 0 = *other types of disability*
Physical efficacy 1	EFF1	Self-efficacy–physical ability, average of 3 items, 1 = *low efficacy* ∼ 7 = *high efficacy*
Physical efficacy 2	EFF2	Self-efficacy–physical expression, average of 3 items, 1 = *low efficacy*, 7 = *high efficacy*

A difficulty in using data on subjective well-being is that individuals may interpret and use the response categories differently. Although survey researchers try to anchor response categories to words that have a common and clear meaning across respondents, no guarantee exists that respondents actually use the scales comparably. An argument in defense of using happiness data comes from evidence that it has often been shown to correlate substantially with other subjective data (see Kahneman & Krueger, 2006). That is, the measure of life satisfaction and various objective physiological and medical criteria are closely correlated.

This regression equation also contains an endogenous variable issue. The problem of reverse causality may exist in the relationship between life satisfaction and physical activity. As participating in physical activity may influence happiness, happier disabled persons could participate more in physical activity. It may be legitimate to consider that disabled persons with better health will be more satisfied with their lives and also would be more active and likely to participate in physical activity. One way to remedy this problem is to control for the status of health and check changes in the coefficient estimates of the physical activity variables. This study adopted two control variables, the efficacy of perceived physical ability (EFF1) and confidence of physical expression (EFF2). These two variables were created by averaging scores of three items each. Items for EFF1 were "I am agile and graceful," "My physique is rather strong," and "I have excellent reflexes." Items for EFF2 were "Sometimes I don't hold up well under stress," "I am sometimes envious of those better looking than myself," and "I am not concerned with the impression my physique makes on others." These items are parts of the "Physical Self-Efficacy Scale" developed and validated by Ryckman, Robbins, Thornton, and Cantrell (1982). These items were selected and slightly revised to fit the special population.

This study applied two different estimation methods for dependent variables. In the case of LS1 (average of multiple item scores), which is continuous in the range from 1 to 7, an ordinary least squares (OLS) method was applied. The OLS method treated life satisfaction scores as cardinal. In contrast, LS2 (single-question scores) is an ordinal dependent variable because the responses are coded as integers (1, 2, ..., 7). Ordinal variables imply that the lower value of LS2 represents "less satisfied in life" and the higher value implies "more satisfied in life." However, it is not necessarily true that the same unit increases in LS2 (e.g., from 1 to 2 and from 6 to 7) indicate the same increase in life satisfaction. This article applies the ordered probit model for this dependent variable and also uses the ordered logit model to check changes in estimates upon model selection.

The happiness regression specification of the ordered probit model, which assumes that life satisfaction is continuous, is as follows:

$$\mathrm{LS}_i^* = \beta_1 \mathrm{PA}_i + \beta_2 \mathrm{Income}_i + \beta_3 \mathrm{Z}_i + \varepsilon_i = X_i\beta + \varepsilon_i, \quad (2)$$

where LS* is actual life satisfaction, which is unobserved, but we observe LS as

$$\mathrm{LS}_i = \begin{cases} 1, & \text{if} \quad \mathrm{LS}_i^* \le c_1 \\ 2, & \text{if} \quad c_1 < \mathrm{LS}_i^* \le c_2 \\ 3, & \text{if} \quad c_2 < \mathrm{LS}_i^* \le c_3 \\ 4, & \text{if} \quad c_3 < \mathrm{LS}_i^* \le c_4 \\ 5, & \text{if} \quad c_4 < \mathrm{LS}_i^* \le c_5 \\ 6, & \text{if} \quad c_5 < \mathrm{LS}_i^* \le c_6 \\ 7, & \text{if} \quad c_6 < \mathrm{LS}_i^* \end{cases}. \quad (3)$$

The cutoff parameters of c_i are unknowns that are to be estimated with β by the maximum-likelihood method. Because marginal effects of changes in the regressors on the probabilities $P(\mathrm{LS} = i/X)$ $(i = 1, 2, \ldots, 7)$ are not linear, both the probability and coefficients of the regressors should be taken into account in calculating the marginal effects. In the case of the ordered probit model, the marginal effects of changes in the regressors are

Table 2. Descriptive Statistics

	LS1	LS2	PA1	PA2	INCOME	UN	DL	DD	Edu	Male
M	3.682	3.988	2.817	49.043	2.009	0.767	2.881	21.057	1.625	0.703
Minimum	1.000	1.000	1.000	0.000	1.000	0.000	1.000	0.000	1.000	0.000
Maximum	7.000	7.000	6.000	300.000	6.000	1.000	6.000	64.000	4.000	1.000
SD	1.276	1.749	1.479	60.980	1.364	0.423	1.453	15.120	0.916	0.457
	Married	Age	DT1	DT2	DT3	DT4	DT5	DT6	EFF1	EFF2
M	0.481	42.211	0.540	0.158	0.076	0.076	0.094	0.055	3.915	3.949
Minimum	0.000	14.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	1.000
Maximum	1.000	79.000	1.000	1.000	1.000	1.000	1.000	1.000	7.000	7.000
SD	0.500	14.667	0.499	0.365	0.266	0.266	0.292	0.228	1.188	1.163

$$\begin{aligned} \frac{\partial \mathrm{P}(LS_i = 1\,|X_i)}{\partial X_i} &= -\phi(c_1 - X_i\beta)\beta \\ \frac{\partial \mathrm{P}(\mathrm{LS}_i = j\,|X_i)}{\partial X_i} &= [\phi(c_{j-1} - X_i\beta) - \phi(c_j - X_i\beta)]\beta, \quad j = 2, \ldots, 6 \\ \frac{\partial \mathrm{P}(\mathrm{LS}_i = 7\,|X_i)}{\partial X_i} &= \phi(c_6 - X_i\beta)\beta, \end{aligned} \tag{4}$$

where ϕ is the probability density function of the standard normal distribution. When β is positively estimated, Equation 4 imply that $\mathrm{P}(\mathrm{LS}_i = 1\,|X_i)$ and $\mathrm{P}(\mathrm{LS}_i = 7\,|X_i)$ must fall and rise, respectively, whereas the directions of the marginal effects in the middle are unambiguous. Thus, values of the probability density play key roles in determining the sign of the marginal effects. However, previous studies (e.g., Ferreri-Carbnell, 2005; Powdthavee, in press-a), which analyzed life satisfaction empirically with the ordered probit model, did not use its advantage to compare the probabilities, but focused only on coefficient estimates.

Descriptive Statistics

Descriptive statistics of the variables used in this study are presented in Table 2. The parametric descriptive statistics for the categorical and dummy variables are presented for the purpose of providing information on the variables. The means of the two life satisfaction variables (LS1, LS2) were above the midpoint, 3.5, indicating that the participants tended to be satisfied with their lives. The mean exercise frequency (PA1) was 2.817, indicating that many people participated in exercise once a month or one to two times per week. The average exercise duration (PA2) was less than an hour (49 min) with rather large variation but more than 80% of physical activity participants were within 30–120 min range. The mean of the "INCOME" variable was 2.009, indicating that their average income was between $500 and $1,000. The answer categories of the "INCOME" variable ranged from 1 to 6, and among these answers, "6" had an infinite range of income (i.e., more than

Table 3. Life Satisfaction and Physical Exercise (Percentages %)

	All	Male	Female	Edu < College	Edu ≥ College
PA1	100	70	30	75	25
Almost none	25	22	30	24	24
Irregular (once a month)	21	22	20	20	26
1–2 a week	21	23	18	23	19
3–4 a week	15	15	14	14	14
5–6 a week	14	14	16	15	13
Everyday	4	4	3	4	5
LS1	100	70	30	75	25
< 2 (dissatisfied)	8	8	8	9	4
<3	22	22	22	22	20
< 4	30	31	26	31	26
< 5	23	22	24	20	32
< 6	12	11	15	12	14
≤7 (satisfied)	5	6	5	5	5

$3,000/month) whereas other answers had determined ranges (see Table 1). Approximately, 77% of the survey respondents were not employed (mean of UN = 0.767). About 70% of the participants were males (male = 0.703), and the mean age was 42.211 years. Both means of self-efficacy variables were also above the midpoint, indicating that the respondents showed a relatively high level of efficacy. The mean disability level (DL) was 2.881, indicating that many people were severely disabled. The mean duration of the disabilities (DD) was about 21 years, and the variation was rather large (*SD* = 15.12). Many were born with their disabilities and/or had lived with their disabilities for a long time. The average education level was between "high school or lower" and "some college" (mean of Edu = 1.625).

Table 3 shows the cross-tabulated percentages of exercise frequency and life satisfaction by gender and education. About 54% of all participants participated in regular exercise. This percentage was a little higher for males (56%) than females (50%). Regarding education level, a smaller percentage of participants who had college degrees or higher (50%) participated in regular exercise compare to participants who did not have college degrees (56%). However, the difference between the two groups was small. Most participants were moderately or highly satisfied with their lives. No notable difference seemed to exist between males and females in life satisfaction. However, the participants who had college degrees tended to be more satisfied with their lives than participants who did not.

Table 4 presents the mean scores for the variables by disability type. The means for life satisfaction variables were relatively higher for the respondents with hearing impairment. People with brain lesions participated in regular exercise more often and longer than people with other types of disabilities. Income was higher for people with physical disabilities and hearing impairment. This was likely because they had

Table 4. Means by Types of Disabilities

	LS1	LS2	PA1	PA2	INCOME	UN	DL
Physical disability	3.615	4.000	2.793	50.793	2.165	0.740	3.063
Brain lesion	3.708	3.921	3.449	63.820	1.978	0.798	2.629
Visual impairment	3.540	3.721	2.628	36.047	1.814	0.814	3.070
Hearing impairment	4.126	4.209	2.442	40.465	2.349	0.698	2.744
Intellectual/emotional disorder	3.864	4.208	2.453	32.170	1.226	0.849	2.283
Other types of disability	3.542	3.742	2.645	48.226	1.710	0.839	2.774
	DD	Edu	Male	Married	Age	EFF1	EFF2
Physical disability	23.408	1.651	0.734	0.418	43.227	3.911	3.979
Brain lesion	13.640	1.618	0.663	0.393	46.157	3.588	3.727
Visual impairment	20.698	1.884	0.558	0.651	40.791	3.923	4.093
Hearing impairment	26.163	1.674	0.721	0.535	36.698	4.248	4.209
Intellectual/emotional disorder	19.245	1.321	0.679	0.830	30.491	4.069	3.830
Other types of disability	15.807	1.484	0.742	0.452	40.774	4.151	3.925

relatively better ability to work than others, so more of them were employed. Education level was highest in the people with visual impairment. Regarding self-efficacy, people with hearing impairments showed higher mean scores than others. In summary, little variation was observed in either exercise frequency or life satisfaction with gender or education.

Estimation Results

Table 5 displays the OLS estimation results of the LS1 regression equations with various combinations of explanatory variables. In the first column, frequency of exercise (PA1) was estimated to be positive and statistically significant. This implies that the people who participates more frequently in physical activity or sport show higher life satisfaction. The third column includes the additional physical activity variable of PA2 (duration of exercise in minutes per exercise). The estimate was positive, but not significant at the 5% level. After controlling for the frequency of the participation, duration does not show a significant relationship with happiness. This implies that the participation itself is more important than the duration to the feeling of happiness. There have been studies to distinguish between sport participation and duration (Eisenberg & Okeke, 2009; Humphreys & Ruseski, 2007). Eisenberg and Okeke (2009) distinguish between participation and duration in their empirical paper about the effect of weather on participation in physical activity and sport. Humphreys and Ruseski (2007, 2009) also developed an economic model of sport participation (extensive margin) and duration (intensive margin) decisions in their

Table 5. Regression Results of Multiple Index: ordinary least squares (OLS) Estimation

Variable	(1)	(2)	(3)	(4)	(5)	(6)
C	3.759* (7.27)	3.864* (7.53)	3.928* (7.63)	2.712* (5.23)	2.757* (5.28)	2.762* (5.39)
PA1	0.113* (3.01)	0.107* (2.82)	0.073 (1.63)	0.076** (2.08)	0.060 (1.39)	0.082** (2.26)
PA2			0.002 (1.43)		0.001 (0.72)	
INCOME	0.053 (1.11)	−0.043 (−0.79)	−0.049 (−0.88)	−0.055 (−1.04)	−0.575 (−1.09)	−0.054 (−1.02)
D_INCOME		1.276* (3.37)	1.261* (3.33)	1.194* (3.29)	1.186* (3.26)	1.176* (3.25)
UN	−0.345** (−2.39)	−0.415** (−2.87)	−0.408* (−2.83)	−0.372* (−2.69)	−0.369* (−2.66)	−0.379* (−2.74)
DL	−0.026 (−0.68)	−0.017 (−0.45)	−0.015 (−0.39)	−0.033 (−0.90)	−0.032 (−0.87)	−0.038 (−1.04)
DD	−0.002 (−0.61)	−0.001 (−0.33)	−0.001 (−0.34)	0.001 (0.30)	0.001 (0.29)	0.001 (0.16)
Edu	0.089 (1.45)	0.108*** (1.77)	0.106*** (1.74)	0.103*** (1.75)	0.102*** (1.74)	0.102*** (1.74)
Male	−0.086 (−0.72)	−0.097 (−0.82)	−0.114 (−0.96)	−0.179 (−1.57)	−0.186 (−1.63)	−0.178 (−1.58)
D_Married	−0.095 (−0.69)	−0.096 (−0.70)	−0.095 (−0.69)	−0.042 (−0.32)	−0.042 (−0.32)	−0.034 (−0.26)
Age/100	−1.970 (−0.85)	−1.744 (−0.76)	−1.919 (−0.84)	−2.851 (−1.29)	−2.918 (−1.32)	−2.882 (−1.31)
$Age^2/100$	0.030 (1.17)	0.028 (1.09)	0.030 (1.18)	0.039 (1.60)	0.040 (1.63)	0.040 (1.63)
DT2	−0.006 (−0.00)	0.003 (0.02)	0.003 (0.02)	0.130 (0.86)	0.128 (0.84)	
DT3	−0.041 (−0.20)	−0.061 (−0.30)	−0.048 (−0.23)	−0.104 (−0.53)	−0.098 (−0.50)	
DT4	0.556* (2.68)	0.613* (2.97)	0.619* (3.00)	0.480** (2.42)	0.484** (2.44)	0.477** (2.44)
DT5	0.379*** (1.88)	0.362*** (1.81)	0.372*** (1.86)	0.322*** (1.68)	0.328*** (1.71)	0.316*** (1.70)
DT6	−0.023 (−0.09)	−0.004 (−0.17)	−0.042 (−0.18)	−0.061 (−0.27)	−0.060 (−0.26)	
EFF1				0.140* (3.08)	0.134* (2.93)	0.136* (3.01)
EFF2				0.244* (5.23)	0.244* (5.22)	0.240* (5.17)
R^2	.061	.008	.084	.159	.159	.157

Note: The numbers in parentheses are z values.
* Significant at $\alpha = .01$.
** Significant at $\alpha = .05$.
*** Significant at $\alpha = .10$.

attempt to quantify the influence of economic, demographic, and environmental determinants of sport participation. Our empirical finding of the differential effect of frequency of participation and duration of an episode of participation on happiness reinforces the importance of distinguishing between participation in physical activity and sport on the extensive and intensive margins.

The second column includes an income dummy variable representing the largest income group (above $3,000) and it had a significant positive effect on life satisfaction, whereas variations in incomes below $3,000 per month did not influence life satisfaction. This is an opposite empirical result to the income threshold argument that once income levels are above a minimal absolute threshold, average satisfaction levels tend to be highly stable over time, even in the face of significant increases in income. This finding may have been due to the peculiar characteristic of our sample data as well. As displayed in Table 2, the mean monthly income was only 2.009, representing a range of $500–$1,000 and about 70% (50%) of the respondents reported their monthly income to be below $1,000 ($500). Taking into account that the per capita gross national income (GNI) of Korea was $21,695 in 2007, the respondents of this survey belonged to a low-income class, on average. Additionally, if the disabled depend financially on their parents or other family members, their own incomes, without controlling for household incomes, may not actually represent their financial environments precisely.

Because individuals with better physical ability may have more physical activity or sport participation and be more satisfied with their lives than those with worse physical ability, an endogeneity problem may exist. Our strategy was to include control variables for the efficacy of perceived physical ability and confidence of physical expression. The estimation results with these control variables are shown in columns 4–6 of Table 5. The estimates are consistent with those without EFF1 and EFF2, with respect to signs and magnitudes of estimates and statistical significance. Thus, regardless of the level of perceived physical ability and physical expression, participating in physical activity positively affect life satisfaction.

We next discuss estimates in the sixth column of Table 5. The impact of physical activity can be compared with the impact of a change in other variables. For example, compared to the impact of unemployment, a one-level increase in the frequency of physical activity is expected to have one-quarter of the impact on subjective well-being as if a disabled person experienced a change in employment status from unemployed to employed. In other words, the increase in life satisfaction when the frequency of physical activity moves from "no exercise" to "5–6 times per week" is expected to be the same as that the employment status moves from unemployed to employed. The negative and significant estimate of unemployment is consistent with the empirical results from previous studies on the nonpecuniary effects of unemployment on life satisfaction. Brereton, Clinch, and Ferreira (2008) using Irish adults sample showed that there is negative effect of unemployment on life satisfaction, regardless of gender and income. Bouazzaoui and Mullet (2005) conducted similar research with a French sample and concluded that when unemployment is present, the effect of other factors on life satisfaction is strongly reduced. Taking into account of the previous empirical findings that employment status has a large impact on life satisfaction, the effect of participating in physical activity on life satisfaction found in this study may be regarded as not only "statistically significant," but also "economically significant" in magnitude.

Age is included in a quadratic form in the specification and the estimates have the conventional U-shape, with a minimum life satisfaction in the late 30s. Gender and marital status had no significant effect, but on average, life satisfaction was higher for those with higher levels of education in this Korean special population.

Several variables are related to disability characteristics. The effects of both the DL and DD were statistically nonsignificant ($p > .05$). This estimation result with respect to the level of disability is consistent with a threshold argument. Once disability levels are above a minimal absolute threshold, the average satisfaction levels tend to be highly stable over time, even in the face of a worsening disability level. Because our sample consists of only disabled, we may assume all levels of disability in the sample are above a minimal absolute threshold.

The nonsignificant impact of the DD is somewhat opposite to the argument of hedonic adaptation to disability, which was supported empirically by previous studies. Oswald and Powdthavee (2008) used the British household panel survey and found evidence of partial adaptation to disability; onset of disability depreciated subjective well-being, but it did so to a lesser degree as the disability lasted longer. They estimated the degree of hedonic adaptation at 30–50% in 3 years. However, our estimation results showed no sign of adaptation to disability, due to a zero coefficient of DD. It is possible that this result was due to our sample characteristic. The individuals in our sample experienced disability for 21 years, on average, which is a long enough period for full adaptation to have already occurred, and then 1 more year of duration did not influence an individual's well-being. Thus, we attempted various specifications to investigate changes in life satisfaction during the 3 (or 6) years span after the onset of disability. An interaction term of DD and a dummy variable, which has a value of 1 if $\text{DD} \leq 3$ (or 6) was added to the set of regressors. This is the same specification as Oswald and Powdthavee (2008) used, but we found nonsignificance from the OLS as well as the ordered probit and logit estimations.

The last variables that are relevant to disability characteristics are the types of disability. Both physical activity and life satisfaction may be affected by the types of disability. Individuals with hearing and visual impairment tend to engage in more vigorous exercise (Washburn et al., 2002) because they are fully functional in terms of motor movement. Most of other types of disability involve limited motor ability. Generally, most of these people need assistant to participate in physical activity. However, how the types of disability affect the participation in physical activity and life satisfaction in detail is not well known, because most studies in the exercise science and psychology area have focused on only one type of disability. In this study, given that all other variables are controlled, type 4 (hearing impairment) had the highest life satisfaction, on average, and type 5 (intellectual/emotional disorder) had the second highest. The differences between these and the reference type (physical disability) were significant. Table 4 shows that individuals with hearing impairment have the lowest frequency of physical activity or sport participation among the six different types of disability in this sample. Therefore, the combined effect of types of disability can be calculated by considering the relationship between disability type and physical activity frequency and the estimates of PA1 and type of disability. In case of a hearing impaired individual, the happiness index is higher by 0.484 than an individual with physical disability because the coefficient of DT4 is 0.484 in the model (Equation 5). However, PA1 of hearing impairment is lower by 0.351 on average than hearing impairment and then the happiness index of the former is smaller by 0.027 (=0.076 $\times$ 0.351) than that of the latter because of the PA1 difference. Therefore, an individual with hearing impairment has the higher happiness index by 0.457 than with physical disability.

Table 6 presents the estimation results, with a single-item score of life satisfaction as a dependent variable. Because the dependent is ordinal, the happiness function was estimated by the ordered probit model, as well as the ordered logit model. The first three columns include estimates of the ordered probit and the last three columns include those of the ordered logit model. No noticeable difference was seen between the two models in the estimation results. Additionally, the estimation results shown in Table 6 are quite similar to those of the OLS method, when the average of multiple-item scores was used as the dependent variable (see Table 5). The only difference is that when other factors were controlled, life satisfaction was expected to be more or less constant over types of disability in the ordered probit model. Thus, the estimates in this study were robust in different estimation models.

Table 7 presents the marginal effects on the probabilities of all levels of LS2, $P(\mathrm{LS} = i/X)$ $(i = 1, 2, \ldots, 7)$. When the frequency of physical activity rises by a level (e.g., from no exercise to once a month), the probabilities of dissatisfied life, such as LS2 = 1 and LS2 = 2, decreased by 0.9% and 1.1%, respectively, whereas the respective probabilities of satisfied life, such as LS2 = 6 and LS2 = 7, increased by 1.3% and 0.8%. The magnitudes of the probability changes were small but significant.

Our empirical findings provide with various information that are useful for policy makers and practical implementation. We find the empirical evidence of not only significant influence of physical activity or sport participation on happiness but also the magnitude of the effect. It can be useful in the cost-benefit analysis of sports facility or sport education program for the disabled because our estimates would be crucial in the measurement of the benefit. It would be also useful for practical implementation if we transform our estimate into the monetary value of life satisfaction gained by an increase in the frequency of physical activity. The empirical evidence that there is a statistically significant relationship between frequency of physical activity and life satisfaction and that the duration of physical activity is not a significant determinant of life satisfaction implies that sport participation programs

Table 6. Regression Results of a Single Index: The Ordered Probit and Logit Models

Variable	Ordered Probit			Ordered Logit		
PA1	0.063** (1.99)	0.036 (.96)	0.065** (2.06)	0.114** (2.05)	0.063 (.97)	0.117** (2.12)
PA2		0.001 (1.43)			0.002 (1.50)	
INCOME	−0.060 (−1.31)	−0.064 (−1.40)	−0.055 (−1.22)	−0.113 (−1.42)	−0.121 (−1.51)	−0.104 (−1.31)
D_INCOME	0.760** (2.39)	0.746** (2.34)	0.738** (2.32)	1.297** (2.33)	1.278** (2.30)	1.266** (2.27)
UN	−0.353* (−2.94)	−0.348* (−2.89)	−0.356* (−2.97)	−0.603* (−2.87)	−0.587* (−2.79)	−0.607* (−2.89)
DL	0.001 (.04)	0.003 (.11)	0.001 (.03)	−0.014 (−0.25)	−0.010 (−0.18)	−0.013 (−0.24)
DD	0.001 (.33)	0.001 (.31)	0.001 (.41)	0.001 (.24)	0.001 (.20)	0.002 (.42)
Edu	0.079 (1.56)	0.078 (1.54)	0.075 (1.49)	0.142 (1.63)	0.143 (1.64)	0.133 (1.54)
Male	−0.156 (−1.58)	−0.169*** (−1.71)	−0.144 (−1.47)	−0.273 (−1.60)	−0.298*** (−1.74)	−0.244 (−1.45)
D_Married	−0.087 (−0.77)	−0.088 (−0.78)	−0.083 (−0.74)	−0.104 (−0.53)	−0.108 (−0.56)	−0.100 (−0.51)
Age/100	−2.602 (−1.36)	−2.727 (−1.43)	−2.701 (−1.42)	−5.129 (−1.55)	−5.439 (−1.64)	−5.311 (−1.61)
$Age^2/100$	0.035 (1.64)	0.036*** (1.71)	0.036*** (1.70)	0.064*** (1.74)	0.068*** (1.84)	0.067*** (1.81)
DT2	−0.010 (−0.08)	−0.014 (−0.10)		−0.074 (−0.33)	−0.082 (−0.36)	
DT3	−0.180 (−1.06)	−0.170 (−1.00)		−0.376 (−1.32)	−0.364 (−1.27)	
DT4	0.159 (.92)	0.167 (.97)	0.184 (1.08)	0.199 (.66)	0.220 (.73)	0.253 (.85)
DT5	0.201 (1.21)	0.211 (1.27)	0.231 (1.43)	0.184 (.64)	0.206 (.72)	0.254 (.91)
DT6	−0.111 (−.56)	−0.112 (−.56)		−0.173 (−.48)	−0.167 (−.46)	
EFF1	0.046 (1.16)	0.037 (.93)	0.045 (1.13)	0.111 (1.53)	0.092 (1.25)	0.110 (1.52)
EFF2	0.205* (4.95)	0.205* (4.96)	0.203* (4.94)	0.371* (4.85)	0.371* (4.86)	0.366* (4.82)
Limit2	−1.062* (−2.31)	−1.145* (−2.51)	−1.044* (−2.33)	−1.897* (−2.43)	−2.071* (−2.62)	−1.830* (−2.36)
Limit3	−0.296 (−0.66)	−0.378 (−0.83)	−0.279 (−0.62)	−0.515 (−0.66)	−0.686 (−0.88)	−0.450 (−0.59)
Limit4	0.115 (.26)	0.035 (.08)	0.132 (.30)	0.170 (.22)	0.001 (.00)	0.233 (.30)
Limit5	0.714 (1.59)	0.635 (1.40)	0.730 (1.64)	1.147 (1.48)	0.981 (1.25)	1.207 (1.57)
Limit6	1.115* (2.47)	1.038* (2.29)	1.130* (2.53)	1.819* (2.34)	1.656* (2.11)	1.877* (2.44)
Limit7	1.981* (4.35)	1.905* (4.16)	1.994* (4.43)	3.424* (4.34)	3.264* (4.10)	3.480* (4.45)
Pseudo R^2	0.031	0.032	0.030	0.031	0.032	0.030
Wald Chi-squared	58.56	61.77	55.90	57.39	61.42	55.26

Note: The numbers in parentheses are z values.
* Significant at $\alpha = .01$.
** Significant at $\alpha = .05$.
*** Significant at $\alpha = .10$.

Table 7. Marginal Effects on Probability: Probit Model

	Ordered Probit Model						
Variable	Pr(y = 1)	Pr(y = 2)	Pr(y = 3)	Pr(y = 4)	Pr(y = 5)	Pr(y = 6)	Pr(y = 7)
PA1	−0.009 (.052)	−0.011 (.057)	−0.005 (.068)	0.000 (.937)	0.005 (.060)	0.013 (.057)	0.008 (.061)
INCOME	0.007 (.250)	0.010 (.249)	0.004 (.256)	−0.000 (.937)	−0.004 (.257)	−0.108 (.251)	−0.006 (.248)
D_INCOME	−0.059 (<.001)	−0.110 (.004)	−0.067 (.045)	−0.051 (.240)	0.017 (.160)	0.130 (.004)	0.141 (.137)
UN	0.042 (.002)	0.061 (.005)	0.028 (.013)	0.007 (.268)	−0.021 (.002)	−0.069 (.005)	−0.048 (.018)
Edu	−0.010 (.141)	−0.013 (.136)	−0.005 (.139)	0.000 (.937)	0.005 (.148)	0.015 (.137)	0.009 (.130)
Age/100	0.365 (.157)	0.475 (.151)	0.192 (.158)	−0.002 (.937)	−0.188 (.162)	−0.526 (.157)	−0.315 (.145)
Age^2/100	−0.005 (.093)	−0.006 (.084)	−0.003 (.094)	0.000 (.937)	0.003 (.097)	0.007 (.092)	0.004 (.083)
DT4	−0.022 (.248)	−0.032 (.294)	−0.014 (.344)	−0.003 (.641)	0.011 (.226)	0.036 (.303)	0.024 (.366)
DT5	−0.028 (.110)	−0.040 (.141)	−0.018 (.190)	−0.005 (.514)	0.014 (.080)	0.045 (.152)	0.031 (.220)
Variable	Ordered Logit Model						
	Pr(y = 1)	Pr(y = 2)	Pr(y = 3)	Pr(y = 4)	Pr(y = 5)	Pr(y = 6)	Pr(y = 7)
PA1	−.008 (.049)	−0.013 (.051)	−0.006 (.065)	0.001 (.920)	0.006 (.055)	0.015 (.054)	0.007 (.063)
INCOME	0.007 (.220)	0.012 (.217)	0.006 (.225)	−0.000 (.921)	−0.006 (.225)	−0.013 (.217)	−0.006 (.220)
D_INCOME	−0.053 (.001)	−0.108 (.002)	−0.077 (.025)	−0.068 (.217)	0.021 (.283)	0.165 (.012)	0.120 (.183)
UN	0.036 (.004)	0.065 (.004)	0.036 (.013)	0.010 (.274)	−0.028 (.002)	−0.080 (.009)	−0.039 (.027)
Edu	−0.009 (.141)	−0.015 (.133)	−0.007 (.135)	0.000 (.921)	0.007 (.144)	0.017 (.132)	0.007 (.127)
Age/100	0.359 (.125)	0.605 (.118)	0.290 (.128)	−0.005 (.921)	−0.287 (.129)	−0.667 (.124)	−0.295 (.113)
Age^2/100	−0.005 (.088)	−0.008 (.080)	−0.004 (.091)	0.000 (.921)	0.004 (.091)	0.008 (.087)	0.004 (.078)
DT4	−0.016 (.393)	−0.028 (.415)	−0.015 (.458)	−0.003 (.727)	0.012 (.382)	0.033 (.448)	0.015 (.484)
DT5	−0.016 (.347)	−0.028 (.359)	−0.015 (.398)	−0.003 (.692)	0.013 (.327)	0.033 (.393)	0.015 (.428)

Note: The numbers in parentheses are p values.

should emphasis on inducement of frequency rather than intensity. This is an important policy implication for physical education.

Conclusions

This article presents empirical evidence of the importance of physical activity in happiness or life satisfaction in a special population. The findings make distance from the empirical findings from the physical exercise science that has focused on the relationship between physical activity and health, because this article examines the effect of physical activity or sport participation on utility. The data used are from a unique survey by the Korean Sports Association for the Disabled; all respondents were legally disabled. The nonhealth effects of physical activity or sport participation on life satisfaction were found to be positive and statistically significant from all estimations of different specifications and different estimation methods. About a one-level jump in the six-level score of physical activity provides the same improvement in life satisfaction as one-quarter of the effect of the employment status change from unemployed to employed. These findings have strong policy implications about sports and exercise programs and facilities for the disabled. It would be also useful for practical implementation if we could estimate the monetary value of life satisfaction gained by an increase in the frequency of physical activity. However, the lack of precision in our income data prevented such a valuation. We leave this for a future study.

Our focus was on physical activity, but this study dealt with other general issues. In particular, the nonsignificance of the degree of disability in the determination of subjective well-being is consistent with a threshold argument. Because the respondents in this survey were over the threshold of health, variations in the level of disability did not cause further changes in life satisfaction. Our empirical results also support no adaptation to disability in contrast to findings in the psychology literature.

However, the empirical evidence found in this study needs to be examined and compared with different data sets. Our sample lacks some information and may be biased. Household income data are missing, and monthly incomes need to be collected as a continuous variable. Our results would be strengthened when supported by further studies with well-balanced data.

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