

Original Article

Social Network Effects on Post-Traumatic Stress Disorder (PTSD) in Female North Korean Immigrants

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Objectives: The goal of this paper is to examine the social network effects on post-traumatic stress disorder (PTSD) in female North Korean immigrants who entered South Korea in 2007. Specifically, it attempts to verify if the density and composition of networks make a difference after controlling for the network size.

Methods: A multivariate logistic regression is used to probe the effects of social networks using the North Korean Immigrant Panel data set. Because the data set had only completed its initial survey when this paper was written, the analysis was cross-sectional.

Results: The size of the support networks was systematically related to PTSD. Female North Korean immigrants with more supporting ties were less likely to develop PTSD, even after controlling for other risk factors (odds-ratio for one more tie was 0.8). However, once we control for the size of the network, neither the density nor the composition of the networks remains statistically significant.

Conclusions: The prevalence of the PTSD among female North Korean immigrants is alarmingly high, and regardless of the characteristics of supporting network members, the size of the supporting networks provides substantial protection. This implies that a simple strategy that focuses on increasing the number of supporting ties will be effective among North Korean immigrants who entered South Korea in recent years.

Key words: North Korean immigrants, Post-traumatic stress disorder (PTSD), Social networks
J Prev Med Public Health 2011;44(5):191-200

INTRODUCTION

The number of North Korean refugees in South Korea has sharply increased. The number reached 19 535 as of August of 2010. In addition, more than 2000 North Korean settled in South Korea each year from 2006 to 2009 [1]. Studies of the physical and mental health statuses of the North Korean refugees (or immigrants) would have important implications not only for the successful social and economic integration of North Korean refugees but also for South Korean society, which has become a multi-cultural society over a very short period.

The immigration process for North Korean refugees is quite different from that of immigrants from other countries. Most North Korean refugees escape from North Korea under extreme economic and/or political difficulty and typically spend four years on average as refugees [2] without any legal protection in third countries such as China before they enter South Korea. Thus, virtually every one of them has experienced and survived extreme emotional and psychological turmoil.

As a result, the state of their mental health is an essential issue as they settle in South Korea [3-5].

In one study, 35.2% of North Korean immigrants responded that their health status was poor, while only 12.6% of South Korean answered in this manner [6]. With respect to all major mental health statuses such as trauma, stress, and depression, North Korean immigrants had much higher prevalence rates than South Koreans. It was found that 4.69% of North Korean immigrants were suffering from traumatic neurosis, a figure that is much higher than the 0.9% among all South Koreans and even higher than the 1.73% reported among low-income South Koreans. Similarly the prevalence rate of depression was also much higher among North Korean immigrants with compared to South Koreans [7]. According to a report by Hanawon based on an examination of 62 North Korean immigrants who entered South Korea in 2004, the prevalence rates of all types of mental disease among North Korean immigrants were higher than those among South Koreans. In fact, the prevalence rates of mania and schizophrenia were extremely high [8].

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Received: 28 February 2011, Accepted: 12 April 2011

Among various mental problems, post-traumatic stress disorder (PTSD) requires special attention owing to its unusually high prevalence. A study of 170 North Korean refugees in China in 1999 revealed that 56% of them were suffering from PTSD [9], and another study of North Korean immigrants who entered South Korea from 1998 to 2000 showed a PTSD prevalence rate of 29.5% [10]. Other studies also revealed prevalence rates ranged from 26.15% to 27.37% among North Korean immigrants living in South Korea [11].

The PTSD prevalence among North Korean immigrants is somewhat gender-specific. According to the findings of a close examination of 105 female North Korean immigrants who entered South Korea in 2009 and who were raising elementary-aged school children at the time of the survey, 25.7% showed full PTSD based on the DSM-IV criteria and 75% of them said the symptoms had lasted longer than three months [12]. In addition, female North Korean immigrants are much more likely to develop physical symptoms related to PTSD than males [13]. In one study of North Korean immigrants who entered South Korea in 2007, 6.5% of female North Korean immigrants were diagnosed with PTSD, while no male North Korean immigrants were diagnosed with this condition [14]. Another study that followed the North Korean immigrants with PTSD for three years found that all of the immigrants who developed chronic PTSD were female [15]. The North Korean Immigrant Panel (NKIP) data set, which is the basis of the current study, also contained no men with PTSD. Thus, this analysis is limited to female North Korean immigrants only.

Various risk factors of PTSD have been identified. These can be divided into three groups: (1) individual attribute factors such as sex, age, ethnicity, and marital status, (2) factors pertaining to trauma itself, and (3) factors after some form of trauma [16-24]. Among the factors after trauma, social support has been one of the most examined factors [25]. For example, negative social responses to the victims of violent crimes increased the odds of developing PTSD, and this effect was greater for women [26]. Moreover, it was found that a larger social support network for female victims of sexual assault was associated with fewer stress disorders experienced by these women [27]. Similar effects of the size and strength of the social support network of veterans of the Vietnamese war were also found [28].

Many previous studies, however, did not examine the effects of the density and composition of social support networks to the fullest extent, despite the fact that these effects were found to be essential dimensions of social

networks in sociological studies. The density of a network measures how close the alters (the ties) of the ego are to each other; this is well known to have strong and systematic effects on emotional support and thus different mental health statuses [29-32]. The composition of a social network tells us the composition of the alters with regard to various socio-demographic dimensions such as age and sex. In this study, we measure the proportion of South Koreans within the support networks of North Korean immigrants. Thus, this study provides an opportunity to analyze the effects of the density and composition in addition to the main factor considered here, the size of the networks.

METHODS

I. Data Collection

A. Study Population

This study utilized the North Korean Immigrant Panel data set [33]. The sample consists of 500 North Korean defectors among all 2544 North Korean defectors who entered South Korea from January of 2007 to December of 2007. Because one participant was selected per household and the average number of family members was 2.9, the response rate at the household level was 57% (57% = 500 household / 877 household). Considering that this response rate was calculated out of the entire population, it was not negligible by any measure. 389 cases in total were used for the analysis: those who were female and had at least one support network were included while those who were male (n=89) or who had no support network (n=12) were excluded. One of the limitations using data with little variations of the entry period is that it is difficult to identify and examine the risk factors of PTSD that are closely associated with entry timing. However, using this data also has the advantage of offering a way to control for risk factors that closely co-vary with the entry period. Thus, one can identify the significant factors affecting PTSD within a cohort who entered in 2007. Because the data set had only completed its initial survey at the time this study was done, the data set used was cross-sectional.

B. Procedure

Some original survey items were difficult to understand for the North Korean respondents; thus, many items were revised through three pre-tests. With the assistance of government agents, safety officers, and

social welfare workers, we successfully recruited 500 study participants out of all 2544 North Korean defectors who entered South Korea in 2007. They were interviewed face-to-face by sixty-eight interviewers who were trained for the survey items, the survey procedures, and especially for the content and the detailed procedures of the The structured clinical interview for DSM-IV Axis I (SCID- I) from February 9th to 12th of 2009. The data collection procedure was carried out in the respondents' dwellings or at local welfare facilities from April of 2009 to May of 2010.

II. Measures

A. Post-Traumatic Stress Disorder (PTSD)

Clinical diagnosis was based on the Korean version of the SCID- I [34], which has been widely used for diagnosing PTSD. SCID- I is a semi-structured interview for major DSM-IV Axis I diagnoses. It was designed to be administered by a clinician or trained mental health professional [35]. According to the diagnostic criteria of DSM-IV, after experiencing a traumatic event (criterion A) an individual must have at least more than one re-experience of symptoms (criterion B), three avoidance/numbness symptoms (criterion C), and two hyperarousal symptoms (criterion D). Furthermore, these symptoms must continue for more than one month (criterion E) and must arouse severe impairment and/or distress (criterion E). Participants meeting the full set of the diagnostic criteria in the DSM-IV were diagnosed as having PTSD.

B. Traumatic Events

We evaluated the unique traumatic experiences of the North Korean refugees by applying a trauma checklist that was specifically designed for North Korean refugees. The checklist was developed by a research team that had studied and counseled North Korean refugees for more than ten years and consisted of one psychiatrist, two clinical psychologists, and one clinical social welfare specialist. Based on interviews with North Korean refugees and previous measures of traumatic experiences for North Korean refugees, a preliminary checklist was developed that included 26 items for the period in North Korea and 25 items for the escape period. After focus group interviews with the North Korean refugees, the team decided to exclude several items that did not seem to be relevant to the DSM-IV criteria and revised the questionnaire so that it would be better understood by the North Korean refugees. After pre-testing the items for five North Korean refugees, the

team finalized a checklist with 17 items for the period in North Korea and 18 items for the defection period. Respondents were supposed to answer 'yes' or 'no' with regard to each item. A list and the content of the items are shown in Table 2. Internal consistency among the 35 items in total was high (Cronbach's alpha = 0.818) and the Cronbach's alpha was 0.749 and 0.762, respectively, for the period in North Korea and the escape period. This traumatic experience checklist had been used in previous research and had been verified [10,15,36]. We used the simple sum of the total number of experiences without differentiating periods to measure traumatic events, as this produced results that were nearly identical to those obtained when the two periods were differentiated. Some previous studies used the simple sum as we did here [36], while others divided them into different types through a factor analysis [10].

C. Stressful life events

We developed a scale for stressful life events to measure the North Korean refugees' stressful events after they settled in South Korea. Survey items for the North Korean refugees' stressful life events were designed by combining the scale for stressful life events in the general population [37] and that of stressful life events of refugees [38]. Twelve items were finally selected after a series of professional meetings and discussions. Stressful life events included disease, legal punishment, fraud, death of family or relatives, marriage or cohabitation, divorce or separation, and the entrance of North Korean family, and other very prevalent stressful events experienced by North Korean refugees. Respondents were supposed to answer each question by choosing 'yes' or 'no'. The total number of events they experienced was used in our analysis.

D. Social Network Measures

We collected extensive information about the respondents' ego-centric social support networks. Interviewers read the following statement to the respondents: "People need help from acquaintances when they are in trouble. Please think about all the cases in which you received any support for any reason from your family, friends, acquaintances, or from a social welfare institution, public institution, or church after leaving Hanawon. Looking over the period after Hanawon, how many people provided you the support you noted above? Please think of as many as possible, including all of those who gave you even something minor." Respondents could enumerate up to seven names. They were asked about each supporter's sex, age,

national origin, educational level, income, and type of support, as well as when and how they met, the frequency of the meetings and contacts, and the strength of the relationship. Moreover, they were asked about the relationship between each supporter (or 'alter').

The social network size, as a major independent variable in this study, was measured according to the number of people who gave the respondent any support. Other network variables included the network density and the proportion of South Korean supporters. The network density was calculated as the proportion of realized ties relative to the total number of possible ties in each respondent's network. For example, if a respondent's network size was seven, the total number of possible ties would be 28 $((7+1)*7/2=28)$. Thus, the minimum density should be $7/28=0.25$, or 25%, when there are no other ties except the ties between the respondent and each of the seven alters, which should exist by definition. The maximum level of network density is $28/28=1$, 100%, when all alters know each other. The proportion of South Korean supporters was calculated as the number of South Korean supporters over the total number of supporters.

E. Social and Demographic Characteristics

Each subject was interviewed using a structured questionnaire for demographic and socio-economic characteristics data. This included the subject's age, marital status, educational level in North Korea, job status, duration of defection, religion and the subject's householder status. The educational level in North Korea was merged into four groups: below high school, high school, college, and university. Marital status was categorized into three groups: single, married, and divorced or separated. Job status also consisted of three categories: worker, student or housekeeper, and unemployed or disabled. Householder status was broken into three groups: no family, having family but not a householder, and a householder.

III. Statistical Analysis

To predict the binary response variable of PTSD, we adopted the logistic regression model. The number of the respondents who suffered from PTSD was 26 out of 389. Although this prevalence rate ($6.7\% = 26/389$) is not overly high, the results did not change even when we counted 15 additional cases of partial-PTSD as fully developed PTSD (10.54% in total).

Table 1. General characteristics of the study sample

Categorical variables	n	%
Education level in North Korea		
Below high school graduate	21	5.4
High school graduate	285	73.3
College graduate	49	12.6
University graduate	34	8.7
Job status		
Worker	201	51.7
Students/housekeeper	93	23.9
Unemployed/inability	95	24.4
Marital status		
Single	116	29.8
Married	153	39.3
Divorced/separated	120	30.8
Religion		
No	199	51.2
Yes	190	48.8
Householder status		
No family	132	33.9
Not householder	52	13.4
Householder	205	52.7
Total	389	100.0
Continuous variables	Mean	SD
Age	35.61	7.92
Duration of defection	4.77	3.62
Living period in South Korea	1.89	0.29
Total number of traumatic experiences	7.94	4.93
Stressful life events experienced in South Korea	3.21	1.64
Network size	5.68	5.45
Network density	0.69	0.22
% of South Korean supporters	0.32	0.34

SD: standard deviation.

RESULTS

I. General Characteristics of the Study Population

The social and demographic characteristics of the respondents are summarized in Table 1. The mean age was 35.61 (standard deviation [SD]=7.92) and the majority (73.3%) were high school graduates in North Korea. 5.4% reported that they had not graduated from high school. With regard to job status, 51.7% were workers including temporary workers and 23.9% did not work because they were students or housekeepers. 24.4% were unemployed or had no ability to work. In addition, 29.8% were single and 39.3% were married, while 30.8% were divorced or separated. Forty eight percent reported a religion, including Christianity, Roman Catholicism and Buddhism. 33.9% had no family at all, and about half of the subjects (52.7%) were householders with at least two household members. 13.4% were not householders. The mean duration of defection was 4.77 (SD=3.62) years, and average living

Table 2. Frequency of traumatic events experienced by North Korean refugees while living in North Korea and during their defection

Traumatic events ¹	In North Korea	During defection	Total
Unexpected forced separation from family	260 (66.8)	193 (49.6)	317 (81.5)
Eyewitness to a family member, relative, or close neighbor dying or dead from starvation	267 (68.6)	61 (15.7)	277 (71.2)
Life at risk due to shortage of food or extreme cold	256 (65.8)	63 (16.2)	267 (68.6)
Being shot at or being chased	104 (26.7)	108 (27.8)	158 (40.6)
Entry into a correctional center or prison	100 (25.7)	97 (24.9)	147 (37.8)
Experience of unwanted forced marriage or human trafficking	41 (10.5)	124 (31.9)	145 (37.3)
Eyewitness to a public execution of acquaintances	131 (33.7)	13 (3.3)	133 (34.2)
Anxiety resulting from the absence of news about a family member of a close relative after he/she went to find food	112 (28.8)	59 (15.2)	130 (33.4)
Shock due to suicide or death of a family member, relative, or close neighbor	108 (27.8)	36 (9.3)	122 (31.4)
Unexpected betrayal by a trusted person	71 (18.3)	88 (22.6)	120 (30.8)
Life at risk or having disorders due to severe illness	89 (22.9)	52 (13.4)	113 (29.0)
Severely beaten	87 (22.4)	37 (9.5)	103 (26.5)
Anxiety resulting from doubts about one's ideology due to political misconduct or family background	83 (21.3)	30 (7.7)	98 (25.2)
Fear of natural disasters such as flood or fire	86 (22.1)	12 (3.1)	91 (23.4)
Torture	53 (13.6)	18 (4.6)	58 (14.9)
Punishment for a family member's or relative's political misconduct	36 (9.3)	9 (2.3)	37 (9.5)
Sexual abuse or rape	13 (3.3)	15 (3.9)	27 (6.9)
Experience of being captured or deported		175 (45.0)	175 (45.0)
Mean and standard deviation of total traumatic events	4.88 [3.08]	3.06 [2.72]	

¹() = percentage / [] = standard deviation.

period in South Korea was 1.89 (SD=0.29) years. It is noteworthy for the current analysis of PTSD to mention that the variation of the living period in South Korea was relatively short compared to that of the duration of defection. Before entering South Korea, the respondents experienced an average of 7.94 (SD=4.93) traumatic events. After they settled in South Korea, their average number of stressful life events was 3.21 (SD=1.64). The mean network size was 5.68 (SD=5.45) and the mean network density was 69% (SD=22%). The average percent of South Korean supporters was 32% (SD=34%).

II. Traumatic Experiences

The frequency of each type of traumatic experience suffered by the study subjects is shown in Table 2. If we do not differentiate experiences based on periods, the three most experienced events were 'unexpected forced separation from family' (317, 81.5%), 'eyewitness to a family member, relative, or close neighbor dying or experiencing death by starvation' (277, 71.2%), and 'life at risk due to food shortages or extreme coldness' (267, 68.6%). The most frequent experiences during the defection period included 'unexpected forced separation from family' (193, 39.6%), 'experience of capture or deportation' (175, 45.0%), and 'experiences of unwanted forced marriage or human trafficking' (124, 31.9%). In general, traumatic experiences in North Korea

(Mean=4.88) were more frequent than those during the escape from North Korea (Mean=3.06).

III. Results from the Bivariate Analysis

Among 389 female North Korean refugees, 26 (6.7%) were diagnosed as having PTSD. The results of bivariate analyses of the risk factors of PTSD are shown in Table 3. The educational level in North Korea did not have a statistically significant effect on PTSD. However, job status was significantly related to PTSD ($p < 0.001$): people who were unemployed or did not have the ability to work were five times more likely to develop PTSD (17%) than workers (3%) or students/housekeepers (3.2%). Although marital status did not have a statistically significant effect on PTSD, in our sample, divorced/separated participants (10.0%) had more than twice the prevalence rate of PTSD compared to single (4.3%) or married participants (5.9%). PTSD was found to be three times higher among those who reported having a religion (10.5%) than among those who did not (3%). This difference was statistically significant ($p < 0.01$). Although householder status was not a statistically significant factor, those who had no family or were a householder were 1.5 times more likely to develop PTSD than those who had a family but were not a householder.

While age and the duration of defection were not statistically significantly associated with PTSD, people

Table 3. Risk factors of PTSD

Categorical variables	PTSD		Total	χ^2	p-value
	No	Yes			
Education level in North Korea					
Below high school graduate	21 (100.0)	0 (0.0)	21 (100)	3.678	0.298
High school graduate	262 (91.9)	23 (8.1)	285 (100)		
College graduate	47 (95.9)	2 (4.1)	49 (100)		
University graduate	33 (97.1)	1 (2.9)	34 (100)		
Job status					
Worker	195 (97.0)	6 (3.0)	201 (100)	25.336	<0.001
Student/housekeeper	90 (96.8)	3 (3.2)	93 (100)		
Unemployed/inability	78 (82.1)	17 (17.9)	95 (100)		
Marital status					
Single	111 (95.7)	5 (4.3)	116 (100)	3.321	0.190
Married	144 (94.1)	9 (5.9)	153 (100)		
Divorced/separated	108 (90.0)	12 (10.0)	120 (100)		
Religion					
No	193 (97.0)	6 (3.0)	199 (100)	8.792	<0.005
Yes	170 (89.5)	20 (10.5)	190 (100)		
Householder status					
No family	123 (93.2)	9 (6.8)	132 (100)	0.807	0.668
Not householder	50 (96.2)	2 (3.8)	52 (100)		
Householder	190 (92.7)	15 (7.3)	205 (100)		
Continuous variables	PTSD		Total	t-value	p-value
	No	Yes			
Age	35.52 (8.00)	36.89 (6.73)	35.61 (7.92)	-0.848	0.397
Duration of defection	4.82 (3.64)	4.02 (3.40)	4.77 (3.62)	1.096	0.274
Living period in South Korea	1.90 (0.29)	1.78 (0.28)	1.89 (0.29)	1.975	0.049
Total # of traumatic experiences	7.61 (4.68)	12.5 (6.15)	7.94 (4.93)	-5.037	<0.001
Stressful life events experienced	3.16 (1.61)	4.00 (1.79)	3.21 (1.64)	-2.558	0.011
Network size	5.81 (5.59)	3.96 (2.38)	5.68 (5.45)	1.672	0.095
Network density	0.69 (0.22)	0.73 (0.22)	0.69 (0.22)	-1.037	0.300
% of South Korean supporters	0.67 (0.34)	0.58 (0.36)	0.66 (0.35)	1.182	0.238
Total	363 (93.3)	26 (6.7)	389 (100)		

PTSD: post-traumatic stress disorder.

with PTSD had a shorter residence duration in South Korea compared to the non-PTSD group ($p < 0.05$). Moreover, the subjects with PTSD experienced not only more traumatic events but also more stressful life events than those without PTSD ($p < 0.001$). The mean network size of immigrants with PTSD (mean=3.96) was smaller than those without (mean=5.81), which hinted at the possibility of the effects of the social support network size on a reduction of PTSD. However, the network density and proportion of South Korean supporters did not show statistically significant differences.

As these findings were unadjusted, it was necessary to carry out a multivariate logistic analysis to examine which, and to what extent, risk factors remain associated with PTSD symptoms even after controlling for other factors.

IV. Logistic Regression Results

Table 4 displays results from the logistic regression of PTSD on social network variables after controlling for

other risk factors, such as individual attributes and experiences in North Korea or South Korea.

Model 1 contains only individual characteristics as a baseline model. Those who were unemployed or had no ability to work had a substantially higher risk of having PTSD compared to those who were workers or students/housekeepers. Regarding religion, those who reported having a religion showed a higher risk of having PTSD than those who did not. In Model 2, where covariates that were related to the experiences in North Korea were added, people with more traumatic experiences in North Korea were more likely to develop PTSD (odds ratio [OR] for one more experience = 1.224). At the 10% significance level, a longer period of defection statistically significantly decreased the odds of having PTSD (OR=0.87). Although more complex models may be necessary to scrutinize the effects of each type of traumatic experience instead of simply the total number of traumatic experiences, the current simple model is sufficient for the statistical control purposes of

Table 4. Logistic regression on PTSD

Variables	OR (95% CI)		
	Model 1	Model 2	Model 3
Individual attributes			
Age	0.966 (0.907, 1.028)	0.943 (0.882, 1.007)*	0.948 (0.884, 1.016)
Below high school graduate	1.00	1.00	1.00
College graduate	0.542 (0.113, 2.587)	0.587 (0.116, 2.959)	0.664 (0.127, 3.462)
University graduate	0.584 (0.0706, 4.840)	1.236 (0.137, 11.11)	1.587 (0.168, 15.03)
Single	1.00	1.00	1.00
Married	1.318 (0.320, 5.430)	4.256 (0.751, 24.11)	3.711 (0.614, 22.43)
Divorced	2.250 (0.631, 8.029)	4.315 (1.000, 18.61)*	3.674 (0.827, 16.32)*
Unemployed / inability	1.00	1.00	1.00
Worker	0.145 (0.0526, 0.399)***	0.143 (0.0485, 0.423)***	0.145 (0.0481, 0.440)***
Students/housekeeper	0.129 (0.0323, 0.519)**	0.116 (0.0255, 0.526)**	0.104 (0.0210, 0.519)**
Householder	1.00	1.00	1.00
No family	0.967 (0.328, 2.854)	1.328 (0.400, 4.413)	1.664 (0.448, 6.179)
Not householder	0.429 (0.0811, 2.274)	0.501 (0.0840, 2.986)	0.653 (0.104, 4.102)
Have religion	4.422 (1.639, 11.93)**	5.772 (1.940, 17.17)**	5.431 (1.779, 16.58)**
Experiences in North Korea			
Duration of defection		0.871 (0.748, 1.014)*	0.874 (0.743, 1.028)
Total # of traumatic experiences		1.224 (1.118, 1.340)***	1.242 (1.130, 1.365)***
Experiences in South Korea			
Living period in South Korea			0.124 (0.0220, 0.695)*
Stressful life events experienced			1.237 (0.939, 1.630)
Network variables			
Network size			
Network density			
% of South Korea supporters			
Network size × network density			
Network size × % of South Korea supporters			
Observations	389	389	389

OR: odds ratio, CI: confidence interval.

* $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

this study, which focuses on the effects of social networks as major independent variables. Model 3 added the covariates of the experiences in South Korea. A longer residential period in South Korea significantly lowered the risk of having PTSD, while stressful life events experienced did not have a statistically significant effect. Model 4 clearly showed that even after controlling for other covariates, the network size had statistically significant and negative effects on the development of PTSD: a larger network size led to less risk of having PTSD. In Model 5 and Model 6, we failed to find significant effects of the network density and proportion of South Korean supporters on PTSD. Moreover, in Model 7 and Model 8, the interactions between the network size and either the network density or the proportion of South Korean supporters did not show statistically significant effects.

DISCUSSION

Among the individual attributes, employment status and religion had strong effects on PTSD. North Korean immigrants who were unemployed or not able to work

were about four times more likely to develop PTSD compared to other North Korean immigrants who were workers, students, or housekeepers. This relationship must be bi-directional; people with PTSD must have difficulty in finding and maintaining a job. On the opposite side of the coin, unemployed people are usually more likely to develop PTSD. We need a longitudinal data set to tell these two apart, but even with the current cross-sectional analysis, we can draw a tentative useful implication: we need to provide special aid for PTSD in addition to traditional vocational training for more successful economic settlement of these people. As discussed above, nearly 70% of the respondents experienced a life-threatening food shortage or extreme cold, and 37% were forced into marriage or experienced human trafficking. Since female North Korean immigrants experienced tremendous traumas, traditional aid programs for employment will have a very limited effect.

One strong counter-intuitive result was found with regard to religion: immigrants with religion were about 8 times more likely to develop PTSD. We do not believe religious North Korean immigrants were more likely to develop PTSD. Instead, it is possible that people with a

Table 4. Continued

Variables	OR (95% CI)				
	Model 4	Model 5	Model 6	Model 7	Model 8
Individual attributes					
Age	0.939 (0.873, 1.011)*	0.938 (0.871, 1.010)*	0.943 (0.876, 1.016)	0.938 (0.871, 1.011)*	0.945 (0.876, 1.019)
Below high school graduate	1.00	1.00	1.00	1.00	1.00
College graduate	1.086 (0.200, 5.911)	1.052 (0.191, 5.774)	1.035 (0.187, 5.730)	1.056 (0.192, 5.809)	0.997 (0.180, 5.521)
University graduate	2.818 (0.268, 29.64)	2.870 (0.272, 30.29)	2.697 (0.248, 29.36)	2.873 (0.272, 30.37)	2.827 (0.263, 30.41)
Single	1.00	1.00	1.00	1.00	1.00
Married	4.704 (0.703, 31.45)	4.707 (0.700, 31.66)	4.677 (0.676, 32.35)	4.668 (0.691, 31.53)	4.724 (0.682, 32.72)
Divorced	4.295 (0.869, 21.23)*	4.349 (0.873, 21.67)*	4.277 (0.846, 21.62)*	4.289 (0.846, 21.74)*	4.335 (0.861, 21.82)*
Unemployed / inability	1.00	1.00	1.00	1.00	1.00
Worker	0.132 (0.0403, 0.433)***	0.134 (0.0409, 0.442)***	0.147 (0.0439, 0.492)**	0.134 (0.0408, 0.441)***	0.147 (0.0434, 0.495)**
Students/housekeeper	0.106 (0.0205, 0.546)**	0.106 (0.0205, 0.546)**	0.118 (0.0220, 0.634)*	0.104 (0.0195, 0.555)**	0.123 (0.0228, 0.660)*
Householder	1.00	1.00	1.00	1.00	1.00
No family	1.559 (0.400, 6.069)	1.539 (0.393, 6.024)	1.684 (0.421, 6.745)	1.531 (0.390, 6.011)	1.760 (0.436, 7.115)
Not householder	0.584 (0.0924, 3.689)	0.571 (0.0907, 3.596)	0.609 (0.0924, 4.016)	0.563 (0.0878, 3.609)	0.592 (0.0886, 3.959)
Have religion	7.589 (2.321, 24.82)***	7.869 (2.357, 26.27)***	8.131 (2.437, 27.13)***	7.880 (2.357, 26.34)***	8.185 (2.463, 27.21)***
Experiences in North Korea					
Duration of defection	0.853 (0.719, 1.012)*	0.855 (0.721, 1.015)*	0.857 (0.720, 1.021)*	0.855 (0.720, 1.015)*	0.854 (0.717, 1.018)*
Total # of traumatic experiences	1.273 (1.148, 1.413)***	1.276 (1.149, 1.416)***	1.280 (1.152, 1.423)***	1.276 (1.149, 1.416)***	1.283 (1.154, 1.427)***
Experiences in South Korea					
Living period in South Korea	0.112 (0.0182, 0.689)*	0.112 (0.0181, 0.687)*	0.103 (0.0162, 0.656)*	0.112 (0.0181, 0.688)*	0.102 (0.0161, 0.644)*
Stressful life events experienced	1.215 (0.920, 1.606)	1.205 (0.910, 1.596)	1.195 (0.899, 1.588)	1.205 (0.909, 1.596)	1.201 (0.904, 1.596)
Network variables					
Network size	0.761 (0.604, 0.959)*	0.778 (0.604, 1.002)*	0.760 (0.602, 0.961)*	0.810 (0.383, 1.716)	0.660 (0.387, 1.125)
Network density		1.680 (0.114, 24.82)		2.093 (0.0191, 228.9)	
% of South Korea supporters			0.513 (0.120, 2.195)		0.258 (0.0180, 3.707)
Network size × network density				0.943 (0.335, 2.650)	
Network size × % of South Korean supporters					1.221 (0.634, 2.350)
Observations	389	389	389	389	389

OR: odds ratio, CI: confidence interval.

* $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

serious stress disorder relied on religion. This has crucial implications for religious institutions (mostly churches), which are trying to evangelize North Korean immigrants: immigrants who were religious were on average more likely to have PTSD, implying that religious institutions need to develop special programs to provide information or counseling.

After controlling for other risk factors, stressful life events in South Korea had no independent effect on PTSD. However, the living period in South Korea showed a strong effect in that people who lived longer were less likely to develop PTSD. Perhaps a longer duration allows for better social and cultural adaptation and helps to overcome the effects of various types of trauma [39].

With regard to support networks, size showed a strong effect. Even after controlling for other risk factors, immigrants with more supportive people were less likely to develop PTSD (the OR for one more supportive tie was about 0.8). However, once size was controlled for, neither density nor composition had an effect. In other words, among the female immigrants who entered South Korea in recent years, the number of supportive ties the immigrants had was solely important, whereas how

close the alters were to each other or how many South Koreans existed the supportive networks was not statistically significant. This implies that we need to consider the size of the supportive network as one of the most important dimensions when we develop strategies for helping North Korean immigrants.

Because the data included only North Korean immigrants who entered South Korea in 2007, we cannot generalize our findings to all North Korean immigrants. We believe, however, that our study has one advantage: the entry year was controlled for automatically. We drew several conclusions that may be applicable to female North Korean immigrants whose living period in South Korea is around two years. With regard to their support network, the size of the network was found to be related to PTSD, whereas its density and composition was not.

ACKNOWLEDGEMENTS

This work was supported by the National Research Foundation of Korea Grant funded by the Korean Government (NRF-2009-1-B00040).

CONFLICT OF INTEREST

The authors have no conflicts of interest with the material presented in this paper.

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