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The Relationships Between Migration-related Stress and Vascular Hemodynamic Factors Based on Migration Duration*

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ABSTRACT

Migration is a very stress-inducing phenomenon. During the migration process, an overreaction of the autonomic nervous system due to a chronic, unexpected, or non-modifiable stressor can precipitate cardiovascular dysregulation. However, the effect of migratory stress on cardiovascular disease remains unclear. The study population consisted of migrant subjects who were seen at Ansan Vincent's Free Clinic between July 2004 and January 2008. Among subjects who were interviewed by a social worker, 510 (282 males, mean age 42±12 years) were enrolled in this study. Men were more frequently employed than women ($p<0.0001$). The most common reasons for presenting to the clinic were orthopedic problems (24.8%), followed by respiratory problems (14%), including the common cold. The patients were divided into two migration groups based on a period of three years. The incidence of HBP between the two groups was similar. After adjusting for cardiovascular risk factors, the migration period correlated with SBP [β =1.066, 95% confidence interval (CI) 1.013-1.122, p=0.014] and PP (β =1.057, 95% CI 1.010-1.107, p=0.016). In conclusion, migrants with cardiovascular disease have a risk factor of developing vascular change resulting from disturbances caused by differences in repetitive, social and cultural stimuli. Further studies are required to confirm this.

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1. Introduction

Migration is a complex topic of study in sociology, transcultural psychiatry, and multiple health fields and has received much recent attention. Global migration is reaching record high levels, and the number of foreigners staying in Korea has increased annually to exceed 2 million. In particular, migrant workers often find themselves simultaneously needed but unwanted, as they are deemed indispensable to growing economies, yet a threat to cultural and national identities. This bears important health consequences, as the migratory process causes significant stress both mentally and physically (Butler et al., 2015). For example, a previous study found that family separation, including separation from children and spouse, is an important source of migration-related stress; in particular, the effect of child separation is strong for migrant women (Guo et al., 2016). However, the relation between migration-related stress and physical health remains unclear.

During the migration process, an overactivation of the autonomic nervous system due to a chronic, unexpected, or non-modifiable stressor can precipitate cardiovascular dysregulation. Overriding the parasympathetic nervous system causes tachycardia, hypertension (HBP), and a reduction in heart rate variability (Barton et al., 2007). A previous study demonstrates that rural-urban migration leads to an age-related rise in blood pressure (BP) and an increase in the prevalence of HBP (He et al., 1991). However, in another previous study, the authors suggested that a longer stay in inner London likely does not have a hypertensive effect on Bengali immigrants from a rural community (Silman, Evans, & Loysen, 1987). Therefore, the events that link psychological, social, and environmental stress to cardiovascular disease have not been fully clarified.

BP is the pressure exerted by circulating blood on the walls of blood vessels, usually in large arteries of systemic circulation (Secomb, 2016). BP is usually expressed in terms of systolic pressure (SBP, maximum during one heart beat) and diastolic pressure (DBP, minimum of two heart beats). Pulse pressure (PP) is the difference between SBP and DBP. HBP is a risk factor for many diseases, including heart disease, stroke, and kidney failure, and is the most preventable major risk factor for cardiovascular morbidity and mortality in the general population (Shrout, Rudy, & Piascik, 2017). The cardiovascular disease risk assessment was improved by considering both SBP and DBP together, not just SBP, DBP, or PP separately (Kikuya et al., 2000; Yusuf et al., 2004).

Currently, the effect of migratory stress on cardiovascular disease remains unclear. Therefore, the aim of this study was to elucidate the relationships between migration-related stress and hemodynamic factors of blood vessels based on migration duration for migrants in the Ansan area.

2. Materials and Methods

2.1 Study population

The study population consisted of migrant subjects who were 18 years of age or older and visited Ansan Vincent's Free Clinic between July 2004 and January 2008. Among subjects who were

interviewed by a social worker, 510 (282 male, mean age 42±12 years) were enrolled in this study. The hospital ethics committee approved the use of clinical data for this study. This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2016S1A5B6914089). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

2.2 Measurement of brachial blood pressure

After at least 10 minutes of rest, the brachial BP was measured using an HEM-907 automatic cuff oscillometric device (Omron Healthcare) while the subject was seated. The average of two readings was used to determine systolic BP, diastolic BP, mean arterial pressure, pulse pressure (PP), and pulsatile stress (PS). PS was defined as the product of heart rate and peripheral PP. Systemic hypertension was defined as systolic pressure $\geq$ 140 mmHg and/or diastolic pressure $\geq$ 90 mmHg based on more than three measurements or as the current use of antihypertensive drugs.

2.3 Clinical and biochemical assessment

Blood specimens were collected after a 12- to 14-hour fast (8:00 p.m. to 9:30 a.m.) in order to reduce the influence of circadian variation. Total cholesterol (TC) and triglyceride (TG) concentrations were measured using standard enzyme methods. High-density lipoprotein (HDL) cholesterol was measured after precipitation of very low-density lipoprotein and low-density lipoprotein (LDL) with phosphotungstic acid. LDL was calculated using the Friedewald formula, and fasting glucose was enzymatically determined using the hexokinase method.

3. Statistical analyses

This study used software called NVivo 11 to analyze non-numerical and unstructured data or data obtained by a social worker on interview.

Continuous variables are presented as mean ± standard deviation, and categorical variables are presented as absolute and relative frequencies (%). Pearson's correlation was used to determine the associations between morphologic and hemodynamic parameters of the carotid artery, central hemodynamics, and risk factors at baseline. The independent predictors of morphologic and hemodynamic parameters were examined using multivariate regression analysis after adjustment. All reported p-values were two-sided, and p-values $\leq$ 0.05 were considered statistically significant. All statistical analyses were conducted in SAS 9.1 statistical software (SAS Institute, Cary, NC, USA).

4. Results

Table 1. Baseline characteristics of the total study population

	Total (N=510)	Women (n=228)	Men (n=282)	p value
Age, years	42±12	45±12	39±11	< 0.0001
Nationality, n (%)				
CIS	84 (16.5)	43 (18.9)	41 (14.5)	
China	193 (37.8)	129 (56.6)	64 (22.7)	
Marital state	502 (98.4)	225 (98.7)	277 (98.2)	
Unmarried	109 (21.7)	19 (8.4)	90 (32.5)	
Married	350 (69.7)	172 (76.4)	178 (64.3)	
Divorce	20 (4.0)	14 (6.2)	6 (2.2)	
Seperation	1 (0.2)	1 (0.4)	0 (0)	
Bereavement	21 (4.2)	19 (8.4)	2 (0.7)	
Living together	1 (0.2)	0 (0)	1 (0.4)	
Occupation, n (%)	399 (78.2)	156 (71.9)	243 (88.7)	< 0.0001
Professionals and related workers	1 (0.3)	1 (0.6)	0 (0)	
Clerks	22 (5.5)	13 (8.3)	9 (3.7)	
Service Workers	2 (0.5)	1 (0.6)	1 (0.4)	
Skilled Agricultural, Forestry and Fishery Workers	3 (0.8)	1 (0.6)	2 (0.8)	
Craft and Related Trades Workers	1 (0.3)	0 (0)	1 (0.4)	
Plant, Machine Operators and Assemblers	207 (51.9)	44 (28.2)	163 (67.1)	
Elementary Occupations	163 (40.9)	96 (61.5)	67 (27.6)	
Type of residence	413 (81.0)	190 (83.3)	223 (79.1)	
Monthly payment	137 (59.1)	137 (72.1)	107 (48.0)	
Deposit	3 (0.7)	1 (0.5)	2 (0.9)	
Dormitory	135 (32.7)	44 (23.2)	91 (40.8)	
Residence in church, community	30 (7.3)	8 (4.2)	22 (9.9)	
Homelessness	1 (0.2)	0 (0)	1 (0.4)	
Migrant period, n (%)	472 (92.5)	211 (92.5)	261 (92.6)	
<3year	96 (20.3)	44 (20.9)	52 (19.9)	
1-3years	135 (28.6)	69 (32.7)	66 (25.3)	
3-5years	109 (23.1)	54 (25.6)	55 (21.1)	
5-7years	69 (14.6)	26 (12.3)	43 (16.5)	
7-9years	48 (10.2)	16 (7.6)	32 (12.3)	
>9years	15 (3.2)	2 (0.9)	13 (5.0)	

CIS (Commonwealth of Independent States): Russia, Ukraine, Belarus, Moldova, Kazakhstan, Uzbekistan, Turkmenistan, Tajikistan, Kyrgyzstan, Armenia, Azerbaijan

The baseline subject characteristics of the 510 patients are shown in Table 1. The mean age of the study participants was 42±12 years, and 282 subjects (55.3%) were men. The mean age

of the men (39±11 years) was younger than that of women (45±12 years) ($p<0.0001$). Men had more occupations than women ($p<0.0001$), according to Korean standard classification of occupations (Kim et al., 2005). Although immigrants were of various nationalities, most of the migrants came from the Korean-Chinese (n=193, 37.8%) and the Commonwealth of Independent States (84, 16.5%) between July 2004 and January 2008. The majority of subjects were married (78.1%). A total of 270 (52.9%) of 510 migrants were interviewed, and 240 (88.9%) of the 270 respondents had family separation experiences, including child or spouse separation. Additionally, most immigrants (n=413, 81.0%) who supplied information about their residence type were living in rented apartments (n=137, 59.1%) or factory dormitories (135, 32.7%). Among the interview data, there were 472 subjects who showed migration period. The period of migration was less than 1 year in 96 (20.3%) migrants, 1-3 years in 135 (28.6%) migrants, 3-5 years in 109 (23.1%) migrants, 5-7 years in 69 (14.6%) migrants, and over 7 years in 63 (13.4%) migrants. Compatriots and Korean-Chinese were included, so many long-term residents were assessed in the study, as well.

Table 2. Baseline characteristics of the total study population for Ansan Vincent free clinic

	Total (N=510)	Women (n=228)	Men (n=282)	p value
Age, years	42±12	45±12	39±11	< 0.0001
Method of knowing, n (%)	469 (92)	211 (92.5)	258 (91.5)	
Family or relation, n (%)	20 (4.3)	12 (5.7)	8 (3.1)	
neighborhood, n (%)	189 (40.3)	103 (48.8)	86 (33.3)	
Friend, n (%)	97 (20.7)	31 (14.7)	66 (25.6)	
News paper or network, n (%)	14 (3.0)	10 (4.7)	4 (1.6)	
non-governmental organization, n (%)	111 (23.7)	31 (14.7)	80 (31.0)	
Occupation, n (%)	1 (0.2)	0 (0)	1 (0.4)	
Others, n (%)	37 (7.9)	24 (11.4)	13 (5.0)	
Clief complaint	508 (99.6)	227 (99.6)	281 (99.6)	
Health consultation	26 (5.1)	8 (3.5)	18 (6.4)	
Problem of respiratory symptom	71 (14.0)	27 (11.9)	44 (15.7)	
Problem of Urologic, kidney, Obstetric gynecology	26 (5.1)	15 (6.6)	11 (3.9)	
Problem of orthopedics	126 (24.8)	57 (6.6)	69 (24.6)	
Trauma, injury	47 (9.6)	15 (6.6)	32 (11.4)	
Problem of gastrointestinal and hepatic symptom	97 (9.3)	48 (21.1)	49 (17.4)	
Problem of neurologic symptom	23 (4.5)	13 (5.7)	10 (3.6)	
Problem of cardiovascular symptom	34 (6.9)	21 (9.3)	14 (5.0)	
Others	57 (11.2)	23 (10.1)	34 (12.1)	

Table 2 shows the baseline characteristics of the total study population for the Ansan Vincent free clinic. Men were introduced to the Ansan Vincent free clinic mainly through neighborhoods (33.3%), non-governmental organizations (31.0%), or friends (25.6%), while women found the clinic

through neighborhoods (48.8%). The most common reasons for presenting to the clinic were orthopedic problems (24.6%) in men, followed by gastrointestinal and hepatic problems (17.4%), including abdominal pain. In women, gastrointestinal and hepatic problems (21.1%) including digestion were the most common, followed by respiratory problems (11.9%), including common colds. Also, orthopedic problems (6.6%) were less frequent in women than in men.

Table 3. Sociocultural and clinical characteristics of the study population according to migrant period

	Group1 (n=231)	Group2 (n=241)	p value
Age, yrs	42±12	41±11	0.462
Male, n (%)	117 (50.9)	143 (59.3)	0.040
Weight, kg	64.0±12.7	64.5±10.2	0.779
Height, centimiter	162±10	163±8	0.608
Body Mass Index, kg/m^2	24.8±3.4	24.3±2.9	0.388
Smoking, n (%)	9 (3.8)	5 (2.1)	0.168
Occupation state, n (%)	134 (58.0)	155 (64.3)	0.101
Medication, n (%)	199 (86.1)	217 (90.1)	0.016
Hypertension, n (%)	32 (13.8)	41 (13.3)	0.133
Systolic Blood Pressure, mmHg	127±21	129±20	0.189
Diastolic Blood Pressure, mmHg	78±16	77±14	0.643
Pulse Pressure	49±13	52±15	0.015
Heart Rate, beats/min	72±11	73±12	0.812
Pulsatile Stress	3564±1040	3860±1311	0.024
Hemoglobin, mg/dL	13.4±1.7	13.6±1.9	0.351
Fasting plasma glucose, mg/dL	117±67	119±44	0.946
Creatinine, mg/dL	1.06±0.3	1.01±0.2	0.123
Total Cholesterol, mg/dL	198±43	204±43	0.221
Triglyceride, mg/dL	171±11	186±18	0.483

To analyze the sociocultural and medical characteristics based on the migration period, the subjects were divided into two groups based on a migration period of three years. Group 1 was defined as the group with a migration period less than three years, and Group 2 was defined as the group with a migration period of three years or more. Table 3 shows the comparison of sociocultural, vascular hemodynamic factors, and clinical laboratory findings according to migration period. There were statistically significant differences in number of men, subjects taking medication, PP, and PS between the two groups. There were no diabetic patients, and about 13% of patients were hypertensive. The incidence of HBP between the two groups was similar. After adjusting for age, sex, body mass index, fasting plasma glucose, smoking history, HBP, and medications, migration period was found to correlate with SBP and PP (Table 4).

Table 4. Associations between residence period of immigrant and index of peripheral hemodynamics using multivariate analysis

Dependent variable	Independent variable	Exp (B)	95 % CI	p value
Residence period	SBP	1.066	1.013 to 1.122	0.014
	PP	1.057	1.010 to 1.107	0.016

Adjusted for age, sex, body mass index, fasting plasma glucose, smoking, hypertension, medication

5. Discussion

The objective of this study was to elucidate the associations between migration-related stress and vascular hemodynamic factors according to migration duration. The role of vascular hemodynamic parameters as early markers of cardiovascular disease in the context of migration-related stress is contentious. The present study demonstrates that SBP and PP are associated with migration-related stress based on migration duration after adjusting for traditional cardiovascular risk factors; however, the degree of change in BP was not high enough to diagnose HBP. In our previous study, it is possible that changes in central BP might have altered cardiac function in patients with normal peripheral BP (Kim et al., 2014). Therefore, the assessment of vascular hemodynamic factors might be useful in detecting cardiovascular disease of migrants.

Migration can be a very stress-inducing phenomenon. Once migration has occurred, additional factors like negative or positive life events or bereavement issues related to loss of relationships, assets, and support might become relevant (Bhugra, 2004). Even if healthy people migrate, the chronic stress from the migration can affect health over time (McDonald & Kennedy, 2004). In future studies of migrants, the difficulty will be to take into account the multi-dimensional aspects responsible for promoting migrant health, focusing on the ethnicity aspects that influence the relationships between migration-related stress dimensions and health outcomes (Keys et al., 2015). In particular, for the migrant worker, language barriers associated with acculturation might have significant impacts in the workplace. For this reason, the integration of work-related stress research and cross-cultural approaches could improve interactions with migrant workers in the workplace (Capasso, Zurlo, & Smith, 2016). In this study, we used interview data to identify migrants and to examine the physical markers of health, such as SBP, DBP, HR and PP. Because BP is influenced by cardiac output, total peripheral resistance, and arterial stiffness and can vary depending on situation, emotional state, activity, and relative disease state, these vascular hemodynamic parameters are considered important markers of cardiovascular disease risk (Domanski et al., 2002; Lewington et al., 2002; Yusuf et al., 2004).

In the Cardiovascular Health in Ambulatory Care Research Team (CANHEART) Immigrant Study, striking differences in the incidence of cardiovascular events exist between the different ethnicities of immigrants to Canada. Traditional risk factors explain part but not all of these differences (Tu et al., 2015). Depending on the duration of migration, the individual migrant responds to a number of stressors related to the preparation, process, and post-migration adjustment (Bhugra, 2004; Vaccarino

et al., 2013). Migration is a lifelong series of events that impacts the lives of all involved, due to the movement of people in or out of communities and the resulting changes. Although it is generally accepted that psychological stress can lead to adverse cardiovascular consequences, the underlying mechanisms are not well understood. The personal characteristics and attitudes toward stress also influence pathophysiological responses. A confounding factor is that migrants also have a unique ability to adaptation to chronic stressors, which diminishes the magnitude of adverse reactions over time (Golbidi, Frisbee, & Laher, 2015).

In this study, we qualitatively analyzed the effects of migration-related stress on hemodynamic parameters of BP, PP and HR of migrants. There are some limitations to the present study. First, this study was cross-sectional, so any causal relationships between vascular hemodynamic parameters and migration-related stress must be fully established by a subsequent prospective study. Second, the qualitative data used in this study were obtained from interviews that assessed the subject's reason for coming to the free clinic. There is insufficient comprehensive analysis on the stress induced by migration, so a qualitative study on the life history of migrants will be needed in the future.

The results of the current study indicate that, depending on the migration duration, vascular hemodynamic parameters in migrants without diabetes are associated with SBP and PP after adjusting for age, sex, body mass index, fasting plasma glucose, smoking history, HBP, and medications. In conclusion, the results of this study suggest that it is possible that migrants with low risk of cardiovascular disease can develop a change in blood vessels due to disturbances in their social and cultural environments. Additional studies are required to further clarify these conclusions.

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