The health status of persons with stress in Canada:

The role of individual network

Jianye Liu

Department of Sociology

Lakehead University

Thunder Bay, Ontario P7B 5E1 Canada

Jliu8@lakehead.ca

Roderic Beaujot

Department of Sociology

Western University -- Canada

London, Ontario N6A 5C2, Canada

rbeaujot@uwo.ca

Zenaida Ravanera

Department of Sociology

Western University -- Canada

London, Ontario N6A 5C2, Canada

ravanera@uwo.ca

Paper to be presented at Session 11-02: *Social networks and demographic outcomes*, **International Population Conference**, International Union for the Scientific Study of Population, Busan, Korea, 26-31 August 2013.

Dated: 15 August 2013

Abstract

The relationship between social network and health status is examined by utilizing public use data from the 2008 General Social Survey on social networks. The study examines the effect of various features of individual networks on health status. We use a resilience measure of health status which indicates the change of health status in five years (much worse to much better). A person's network is operationalized by five items: size and strength of the network of relatives, size and strength of the friendship network, and the occupational composition of network. We observe associations between these network indicators and the respondent's sense of their changed level of health compared to five years ago. In particular, the strength of the network of relatives reduces the magnitude of negative relationship between stress and the resilience measure. This study also finds that males are benefiting more from relative strength in gaining better health compared to females. This study shows us the five components of individual network have quite different functions and roles in our life. Further research is needed on the role of public and professional networks on social life and on dealing with the health consequences of stress.

Introduction

Stress is quite common to each individual in our social life. Research in health, sociology, and psychology has made clear link between stress and health. Individuals living in stressful situation are more likely to develop behavioral and psychological problem (Garmezy and Rutter, 1983). However, not all individual experiencing stressful events have health issues (Antonovsky, 1979, 1987). Those survived from the adverse situations are defined as resilient. According to Antonovsky (1987), whether a stressed individual will have health problems depends on resources available to them such as money, social support and so on. People living in adverse situation need resources help them solve the problems they are facing and get back to the normal situation.

As social animals, people are linked by social network which can be defined as the social structure between persons, groups or organizations (Thilagam, 2010; Watts, 2004). Social network is the core of social structure and used by individuals to link them to the society like connections among relatives, friends, neighbours, colleagues, and so on (Murata, 2010; Zhang, 2010). In general, social network offers each of us a unique social environment which determines how each individual integrate to the society like the social role, to whom and how we are related. Moreover, social network is the bridge or channel transmitting resources among individuals connected by the social network. That's why the social network is considered as a very important part in Social-Resource Theory and Social-Capital Theory (Zhang, 2010). Social network basically can offer various supports to individuals in need. However, the foci of most of the social network research are either the development of social network by using mathematical models to simulate the initiating and expending of network (graph theory) or apply network analysis in case studies like social network in an organization such as firm, company, school and study how the relative power and role of each member of the organization determine the observed social network within the unit. Research on the effect of social network in our normal life is much less, if not rare. In particular, relative few studies investigate how the social network affects individual's general health status.

This study focuses on the effect of social network on the change of health status. We hypothesize that individuals with better network are more likely to keep or even improve their health status. This paper includes a brief literature review of resilience and social network research, followed by methodology used, findings, and concluded by discussion and conclusion.

Literature on resilience and social network

Resilience research refers to a dynamic process encompassing positive adaptation or the ability to maintain or regain normal health status within the context of significant adversity. Therefore, the common subjects of resilience research are usually people

exposing to significant threat or severe adversity such as socio-economic disadvantage and associated risks. Adversity conditions examined have ranged from single stressful life experiences to aggregates across multiple negative events. The thrust of this research is to search for protective factors, that is, those which differentiated people with healthy adaptation profiles from those who were comparatively less well adjusted (Luthar, Cicchetti, and Becker. 2000; McCubbin, Hamilton, and McCubbin, 1988). Moreover, resilience research is trying to figure out how such factors may contribute to positive outcomes, or the mechanism that the protective factors help people get out of various adversity situations. When the protective factors and mechanism are found, appropriate prevention and intervention strategies can be designed to help individuals facing adversity.

One important issue in resilience research is to define the achievement of positive adaptation or resilience. One agreement in defining resilience is that resilience can be seen as the ability to continue the original identity, which could be either qualitative or quantitative change (Cumming, Barnes, Perz, Schmink, Sieving, Southworth, Binford, Holt, Stickler, and Van Holt. 2005). Unfortunately, the theoretical and research literature on resilience so far reflects little consensus about how to operationalize resilience. For instance, Rutter (1987, 1990) has characterized resilience as the positive end of the distribution of developmental outcomes among individuals at high risk. Masten and her colleagues (Masten, 1994; Masten et al., 1990) have distinguished among three groups of resilient phenomena: those where (1) at-risk individuals show better-than-expected outcomes, (2) positive adaptation is maintained despite the occurrence of stressful experiences, and (3) there is a good recovery from trauma.

Individuals living in adverse circumstances (e.g., poverty, minority status, and drug addiction) need resources to survive or get out of it (Ehrhardt, Marsili, and Vega-Redondo. 2007). These resistant resources or protective factors include personal resources and environmental resources (Wayman, 2002). Personal factors are internal attributes and attitudes that the individual uses to buffer the adverse effects of the adverse situation. Environmental factors are external influences that provide support and protect against negative factors threatening the person's resilience (Wang, Haertel, & Walberg, 1997). Social network is a crucial part of environmental resources.

In general, depending on its nature, social network may offer emotional and financial helps, causal personal favors, material, information and communication, and even professional advices or suggestion (Ryan, Kalil, and Leininger, 2009; Sherrieb, Norris, and Galea, 2010). Ryan and et. al. (2009) find that private safety nets which include material support (cash or in-kind financial assistance), and instrumental support (help in caregiving, transportation, and other daily tasks) are positively associated with children's socio-emotional adjustment. Therefore, the social network might provide more opportunities for positive experiences and help individuals to avoid negative ones.

Studies utilizing measures of perceived availability of specific support functions (especially esteem and informational support) also provide evidence consistent with the buffering model. Esteem support theoretically indicates to the individual that he/she is valued by others, perhaps leading to enhanced self-esteem and feelings of mastery over stressors. Informational support may help the individual to understand and cope more effectively with stressors. Wolchik et al. (1987) note that social network may offer informational support which may lessen the impact of stressors by reducing their perceived threat. Moreover, studies show that intra-family support, support of the extended family, support of friends, religion, open communication amongst family members, and work and financial security were factors promoting resilience in these families (Greeff and Van Der Merwe. 2004). Furthermore, individual's social attitude and behavior can also be influenced by his/her social network (Zhang, 2010).

However, individuals involved in the network are both the receiver and giver of social support. Resources flow among individuals linked by the network depending on where the need is ---- the social support is reciprocal. In most of situation, among friends in particular, in order to receive instrumental or material support, one often needs to be able to offer some kind of help in return (Antonucci & Jackson, 1990). Therefore, heavy reliance on support from the network can strain interpersonal relationships and result in as much stress as it alleviates (Antonucci & Jackson, 1990; Howard, 2006). Falci and McNeely (2009) find that adolescents with an either too large or too small network have higher levels of depressive symptoms. A small network may not offer enough support to the needed person within the network. A large network, on the other hand, may cause stress or tension among individuals because of increased duty and obligation associated with the network. There are much more expected emotional and instrumental support such as assistance, accompany and various favors in a large network.

Therefore, the actual effects of social network are contingent upon network properties which have been operationalized in various ways. In Kim and Rhee's study (2010) social network is measured by network size, network tie duration, and composition. Network size is the number of people involved in the personal network. It is a common believe that a large social network might provide more opportunities for positive experiences and help individuals to avoid negative ones. Network tie duration is the mean of the duration (measured by years) of all the network ties. It is actually a measure of strength or closeness of network, which may determine the nature of social support. The composition of the network refers to the heterogeneity or variation of individuals connected by the network. A more heterogeneous network is more likely to offer more types of support or help. In the meantime, closer social network is associated with increased ambivalence (Fingerman, Hay, and Birditt, 2004). Furthermore, the possible support offered by the social network can be distinguished by the source of the support. That is, the support from family members or relatives, friends, public organization, or other sources may be

quite different from each other (Dubow and Tisak, 1989). The possible support offered by a particular member in the network is limited by the nature of the relationship (relatives or friends), the closeness or strength between the support-receiver and support-giver, and the characteristics of the support-giver. Therefore, to capture the full dimensions of network, the network measures should cover its source, size, strength, and heterogeneity.

Data and method

Data used for this study are the General Social Survey (GSS) in 2008. The 2008 GSS focused on social networks, which contain information on individual and public social network. The target population of the 2008 GSS was all people 15 years of age and older in Canada, excluding those in the Northern territories. The sample was selected by using random digit dialing, a telephone sampling method, which may result in that those not listed or not owning a telephone were excluded from the sample, who accounts a very small proportion of the Canadian population. The total sample size is 20, 401.

This study focuses on individuals aged between 25 and 59. We select individuals aged 25-59 for the reason that they are not only generally comparable to each other in terms physical and psychological characteristics, but less likely to be affected by biological factors comparing to young and senior groups as well. The sample size used in this study is 9717. The research question that is going to answer in this research is "whether individual social network helps people become resilient?"

Because of the absence of any universally employed operationalization of resilience, it is necessary for researchers to clearly define resilience. Based on the nature of resilience which refers to the ability to maintain or regain original status, in this particular research, the resilience is defined as "State of health compared to 5 years ago". Therefore, the meaning of resilience means equal or better health than five years ago. The distribution of resilience measure is in Table 1 and it is used as an interval-ratio variable to simplify the analysis even though it is ordinal in nature.

--- Table 1 about here ---

Control variables

The following covariates will be controlled in the analysis to get rid of the spurious effect of network on the resilience measure: age, age square, gender (male/female), marital status (single, married, and not married), work status (working/not working), education level, religion, residence (living in CMA or not), number of children in the household, number of changes experienced in the past year, current general health status. The distribution of all these variables is displayed in Table 1. Age and education attainment

are used as interval-ratio variables. General health status is included to control so-called "Flooring- and Ceiling-effect".

Key variables: network measures and stress level

Individual network is measured by five components: size of relative and friend network, strength of relative and friend network, and network variations. The size of relative network is measured by "number of relative feel close to". The size of friend is simply "number of close friends." The strength of relative and friend network is the summation of frequencies that respondent saw relatives/friend or communicated with relatives/friend by telephone in the past month (5=Every day, 4=A few times a week, 3=Once a week, 2=2 or 3 times a month, 1=Once a month, 0=Not in the past month). The variation of network refers to the number of occupations that a respondent's network members involved in. In the 2008 GSS, respondents were asked whether they knew female/male social workers, police officers or fire-fighters, food or beverage servers, labourers in landscaping or grounds maintenance, managers in sales, marketing or advertising, computer programmers, instructors or leaders in recreation and sport, security guards, engineers, farmers, nurses, janitors or caretakers, accountants or auditors, graphic designers or illustrators, delivery or courier drivers, early childhood educators or assistants, sewing machine operators, carpenters (yes=1, no=0). The summation of answers to all these questions gives us the number of occupations in which the respondent reported knowing anyone. Even though respondents having the same number of occupations in which they have connections may have quite different occupational composition, it is the best thing we can do to capture the variation of the network. The variation of network determines the possible resources that an individual can get from the network. Therefore, the more various the network is, the more likely an individual can find resources to satisfy his/her different needs. We found that the network variation is much higher correlated with the number of resources available to the respondent comparing to the size and strength of network (0.24 VS 0.08). The stress level of respondent is measured by a Likert Scale (extremely stressful to not at all stressful), which is used as an interval-ratio measure to simplify the analysis.

Moreover, there are a lot of debates about the interaction terms in the resilience research. Some researchers think it is not necessary to find interaction effects in resilience research and others believe the interactions is the unique contributions of resilience research and the primary distinction between resilience research and other paradigms (Roosa, 2000). We'd like to test the interaction between social network and stressful measure and see whether the relationship between resilience measure and stress level is moderated by the network variables. Particularly, research indicates that there are quite gender differentials in getting resources from the network. Therefore, the interaction terms between gender and network variables will also be tested. To capture the curvilinear relationship between the size and strength of network and the resilience measure, the squared term of network

size and strength will be included in the analysis. To reduce the correlation between the original variable and the squared term, the stress and network measures have been mean-centered, i.e., the deviation from the mean of variables involved in interaction terms is used in the analysis. You can see the means of stress and network measures are 0 in Table 1. The Univariate module of General Linear Models in SPSS was used in the data analysis. All analyses results are weighted back to the population structure with the same original sample size.

Findings

Bivariate analysis

Bivariate association gives us the strength and direction of relationship between any two variables without any statistically control. Before running the multivariate analysis, it is important to know how variables in the model relate to each other and how the key variables relate to the dependent variable. ANOVA has been used to test whether stress level and network measures are significantly differentiated by categorical control variable and Pearson' r is used to measure the association between interval-ratio variables and those key variables. The results of bivariate analysis are displayed in Table 2.

--- Table 2 about here ---

From Table 2, we can see that, firstly, there are significant gender differentials in stress level, size of relative and friend network, and strength of relative and friend. Females generally have a higher stress level, a larger size of relative network, stronger relative and friend network, but a smaller size of friend network compared to males. Secondly, in terms of marital status, it does make sense to see that married individuals have the largest and the strongest relative network, and the largest network variation. Singled person has the lowest stress level and the strongest friend network. Those neither singled nor married have the highest stress level and the smallest relative network. Thirdly, comparing to those not having a job, working group has a higher value across all these key variables except the strength of relative network. Fourthly, religion has significant effect on network measures, but does not affect stress level. People with no religious believe have the smallest and weakest relative network. Catholic believers have the smallest and weakest friend network, and lest network variation, but the strongest relative network. Protestants, on the other hand, have the largest relative network, and other religious believers have the largest friend network, strongest friend network, and the most network variation. Except the strength of friend network, stress level and other network measures are significantly differentiated by residence. People living in the large urban areas generally have a higher stress level and lower values on all network measures, which indicate that the urban life has more tension and less communication among relatives and friends compared to the rural one.

The second panel in Table 2 is the Pearson's correlation coefficients between age, education level, number of children at home, number of changes experienced in the past year and stress level and network measures. Age is negatively associated with the strength of relative and friend[i] network, and quadratically related with stress, the size of friend and the variation of network. The curvilinear relationships between age and stress, the size of friend network, and the variation of network are displayed in Appendix 1, which is based on the regression of age on the centered original and the squared value of three measures respectively. In general, the stress level increases with age till around 41 and then it starts to decline with age. The size of friend network also increases with age till 36, then declines. But network variation declines till 44 and increases after that with age. Age basically captures the evolution of life course with the natural aging process. The analysis shows us the stress level and network measures actually vary with stages of life course which are quite different in terms of earning and caring (Beaujot, 2000).

Education level is positively associated with stress level, strength of friend network, and variation of network. The number of children at home is positively associated with stress level, size and strength of relative network, and variation of network. Though children are one source of stress, at the same time, children are also the channel to connect their parents to society through school activities, birthday parties, and so on. The number of changes experienced in the past year is positively associated with stress level and all network measures. The general state of health is negatively associated with the stress level and positively associated with all network measures.

The last panel in Table 2 is the bivariate correlation between stress level and network measures and the dependent variable ---- the health status compared to 5 years ago. The stress level affects health status negatively, like its effect on current general health status. The size and strength of relative network have no significant effect on the resilience measure which is different from their effect on the general health status. The size and strength of friend network and network variation are positively associated with the dependent variable.

Multivariate analysis

The multivariate analyses were done in 4 different models (see Table 3). Model 1 only includes control variables, which, as a whole, explains 13.5% of the variation of resilience measure. Model 1 tells us, marital status, work status, religious believe, and residence do not affect resilience measure in a significant way even though they did in the bivariate analysis. On the other hand, all other control variables have significant effect on the resilience measure. With all other variables in the model being constant, female is more likely to be resilient compared to their counterparts. The chance of being resilient increases with current health status and the number of changes experienced in the past year, but decreases with education level and number of children at home. The

relationship between age and the dependent variable is curvilinear. The likelihood to be resilience increases with age till around 48 years old, then declines with age (see appendix 2). Again, the finding reflects the nature of life course associated with aging process.

--- Table 3 about here ---

Model 2 is used to test the curvilinear relation between network measures and resilience by including squared network measures while controlling variables tested in model 1. Model 2 explains 15.7% of the variation of the dependent variable. The squared terms of size and strength of relative network, and the strength of friend network are statistically significant, which indicates clear quadratic relationship between resilience measure and these three network measures. The size of friend network has no significant effect on the resilience measure. The variation of network has a pure linear and positive association with the resilience measure. When all other variables are equal to zero, the change of resilience measure with the size and strength of relative network, and the strength of friend network within the observed range of these variables in the data set (in Table 1) is shown in Figure 1a, Figure 1b, and Figure 1c respectively.

--- Figure 1a, Figure 1b, and Figure 1c about here ---

Figure 1a shows that, with the increase of the size of relative network, the resilience measure slowly decreases until it reaches 64. Beyond 64 relatives, the direction of the association reverses, the chance of being resilience increases along with the size of relative network. Individuals with no living or close relatives have the same resilience level with those having 122 relatives on average. However, the effect of the strength of relative network on resilience measure is opposite (see Figure 1b): the resilience measure increases with the strength of relative network until it is 4.6, which is one unit below the mean of the strength of relative network (5.55); after that, the dependent variable decreases with the strength of relative network. The resilience measure shares the same value when the strength of relative network is 0 (very weak) and when it is 9.5 (very strong, the maximum value of relative strength is 10 in the study).

Furthermore, the significance of the squared strength of friend network indicates a quadratic relationship between the strength of friend network and resilience measure. The weak friendship does not increase but decrease the chance of being resilience: the chance of being resilience is reduced with the increase of friend strength when the friend strength in general is weak (see Figure 1c). Only when the friend network is strong enough (more than 4, the range of friend strength is 0-10), the chance of being resilience starts to increase.

In sum, the relationship between the resilience measure and relative and friend network can be summarized as, firstly, relative size may help individual to become more

resilience if it is large enough. Relatives should be a good source of emotional, information, and even financial support. If it is too small, individual may not get all the support they need when facing adverse event. However, the size of relative network is determined by the kinship or blood linkage and cannot be simply extended. In the meantime, it is not easy to break a relative network because of its kinship nature. So the size of relative network is out of individuals' control. On the other hand, the strength of relative network can be developed after the relative network is created. But it seems it is not good to have a very strong relative network. Previous research indicates that a strong relative network is associated with much obligation and duty. Sometimes, the obligation and duty needed by the relatives may interfere with individuals' normal life and become a heavy burden. However, friend network is the result of a selective process. We would like to make friends only with those to whom we can get along with. At the same time, we can cut off any connection with friend if we do not want to keep it. That is, individuals have a certain control of the size and strength of friend network.

--- Figure 2a and Figure 2b about here ---

Model 3 is used to test whether the relationship between stress level and resilience is moderated by network measures by adding interaction terms between stress level and all five network measures. Unfortunately, only the interaction between stress level and the strength of relative network is statistically significant. We use method recommended by Aiken and West (1991) to explain the significant interaction terms. Firstly, we consider how the strength of relative network moderates the relationship between stress level and resilience measure by displaying the regression lines when the strength of relative network has a value of one standard deviation below the mean (LOW), mean (MEAN), and one standard deviation above the mean (HIGH) respectively. The result is shown in Figure 2a. We can see that the regression line is steeper when the strength of relative network is weaker (the solid line) and with the increase of strength of relative network, the regression line is becoming flatter. When the strength of relative network is one standard deviation below the mean, the slope of the regression line is -0.183 and when it is one standard deviation above the mean, it is -0.129. The slope has been reduced almost one-third in magnitude. At the two ends of the observed strength of relative network continuum, the slope is -0.213 at the minimum and -0.11 at the maximum strength of relative network. Therefore, stress level affect more on individuals with a weak relative network like those living alone in terms of resilience comparing to those with a strong relative network.

Secondly, we can check how the stress level moderates the relationship between strength of relative network and resilience measure, which is demonstrated in Figure 2b. Figure 2b is the effect of strength of relative network on resilience when stress level has one SD below the mean (LOW), mean (MEAN), and one SD above the mean (HIGH). It seems when the stress level is low, the strength of relative network mainly has negative effect

on individual's chance of being resilience; at the mean value of stress level, there is almost no relative between strength of relative network and resilience measure ---- the curve almost parallels to the horizontal axis; and the strength of relative network help very stressful individual to get better in terms of health ---- shown by an increasing curve line. One possible explanation is that low stressed individuals are more like to become support-givers and on the other hand, highly stressed individuals are mainly support-receivers.

Model 4 is trying to examine whether the effects of stress level and network measures are moderated by gender. Six interaction terms are added to Model 4 with all significant squared and interaction terms used in the previous models. There are two significant interaction terms. Firstly, the interaction between gender and the strength of relative network is statistically significant which indicates the relation between strength of relative network and resilience measure is quite different for male and female (see Figure 3a). From Figure 3a, we can get that the gender gap is large when the strength of relative network is weak, and it shrinks with the increase of strength of relative network. Within the observed range of strength of relative network, the gender gap in resilience measure, on average, changes from 0.174 to 0.003. Moreover, the strength of relative network affects male more positively and affect female more negatively. That is, even though female are more likely to be resilient in general ---- the female curve is higher than the male one, the female curve starts to go down earlier than male curve. An ANOVA test shows that females' strength of relative network is significant higher than their counterpart (see Table 2). Therefore, it is possible that female is more likely to be burdened by the strong relative network compared to male.

--- Figure 3a and Figure 3b about here ---

The second significant interaction is between gender and the variation of network (p=.005). The result is demonstrated in Figure 3b. Even though the variation of network affects health status positively both for male and female, the effect is much stronger for male than for female (.015 VS .001). The ANOVA test shows gender difference in terms of variation of network is very small and not significant in Canada. The mean of variation of network is 4.04 for male and 4.02 for female (p=.943). Therefore, the significant interaction between gender and network variation indicates that male benefit more or take more advantages associated with variation of network, such as information for job opportunities in different industries, helps for different housework (wire a room, fix a minor issue of car), and so on.

Discussion and conclusion

Network is an important part in our social life as everyone lives in and links each other via a certain network. Generally speaking, network can offer us emotional, informational,

and even financial support. In the particular study, network is measured by five components, size and strength of relative network, size and strength of friend network, and the variation of network, which cover different dimensions of social networks including two sources (relative and friend), size, strength, and heterogeneity of network. As a whole, these network measures have significant impact on the resilience measure ---- state of health compared to 5 years ago. In particular, the size friend network is not related to the change of health status. The variation of network has a positive linear association with the dependent variable, which indicates a wide network covering more occupations is good to your health, as it can provide you quite different supports that may meet your needs. The other three components of network, size and strength of relative network, and strength of friend network, have a significant curvilinear association with the change of health. The size of relative network improve respondents' health status only when it is large enough (more than 64 in this study). The strength of relative network has a positive contribution to health only when it is not too strong (less than 4). A strong relative network (more than 4) may affect your health negatively because of increased obligation and duty associated with the close network. The same story happens to the strength of friend network.

Moreover, the strength of relative network also moderates the negative effect of stress level on health--- the negative effect of stress decreases with the increase of strength of relative network. The negative effect of stress level on the health status at the strongest end of the strength of relative network is only half of the magnitude at the weakest end. Therefore, it seems that we find two contradict results, a strong relative strength affects your health negatively and at the same time, it may also reduce the negative effect of stress. The contradiction shows us the "double-edged" nature of relative network. When the relative network is strong, individuals in the network are more likely to get the support they need, and such, they are more likely to be resilient in an adverse situation. In this scenario, the individual is the support-receiver. On the other hand, a strong relative network also means more responsibility. When some relatives are facing a hard time, others have to offer them the resources they need. The individuals become the support-giver in this situation.

Furthermore, the significant interaction terms between gender and network measures indicate a clear gender differential in benefiting from network. Males are more likely to have a positive relationship between strength of relative network and health status comparing to females because their relative network is weaker and such, have no as much obligation and duty as females who have a much stronger relative network. Males also have a stronger relationship between the variation of network and health status comparing to females.

The major contributions of this study are to measure network by five components, which helpfully capture the main domain of the concept. The second one is to use squared terms

of network measures to examine the curvilinear relationship between network measures and health status. And the last one is to test the gender differences in the relationship between network measures and health status. The findings from this research can be used to answer questions like how and why individuals in similar circumstances but with different networks may have quite different health status. In particular, why network may contribute to a positive development in one situation but have little or no positive impact, or even negative impact, on development in a different scenario.

There are two large limitations in the study. Firstly, we find that answers to size of relative and friend network are piled up on numbers ended with 0 and 5. When respondents do not have a clear number of relatives or friends, they usually give out such a number. Moreover, respondents may have quite different understanding about the meaning of "close" relative or friend, which may result in incoherent answers. Secondly, the study only examines the role of individual network in social life which can offer very limited social support. The other types of networks should be studied in the future research. For instance, the public network which connects individuals and social organization like government, health facility, may be more important source of support to individuals facing adverse situation. The professional network can provide more valuable information, suggestion, and high quality services.

Bibliography

Aiken, S. Leona & West, G. Stephen. 1991. *Multiple Regression: Testing and Interpreting Interactions*. The International Publishers, Sage Publications.

Antonovsky, A. 1979. *Health, Stress and Coping*. San Francisco: JosseyBass Publishers,

Antonovsky, A. 1987. *Unraveling The Mystery of Health How People Manage Stress and Stay Well*. San Francisco: Jossey Bass Publishers

Antonovsky, Aaron. 1990. "Studying Health vs. Studying Disease". Lecture at the Congress for Clinical Psychology and Psychotherapy, Berlin, 19 February 1990.

Antonucci, T. C., & Jackson, J. S. 1990. "The role of reciprocity in social support". In B. R. Sarason, I. G. Sarason, & G. R. Pierce (Eds.), *Social support: An interactional view* (pp. 173 - 198). New York: Wiley.

Beaujot, Roderic. 2000. *Earning and Caring in Canadian Families*. Peterborough: Broadview.

Bergstein, M., Weizman, A., & Solomon, Z. 2008. "Sense of Coherence Among Delusional Patients: Prediction of Remission and Risk of Relapse". *Comprehensive Psychiatry*, 49, 288-296.

Cumming, G. S., G. Barnes, S. Perz, M. Schmink, K. E. Sieving, J. Southworth, M.Binford, R. D. Holt, C. Stickler, and T. Van Holt. 2005. "An Exploratory Framework for the Empirical Measurement of Resilience" Ecosystems 8:975-987.

Dilani, A. P. D. 2008. "Psychosocially supportive design: A salutogenic approach to the design of the physical environment". *Design and Health Scientific Review*, 1(2), 47-55.

Dubow, Eric F. and John Tisak. 1989. "The Relation between Stressful Life Events and Adjustment in Elementary School Children: The Role of Social Support and Social Problem Solving Skills." *Child Development* 60:1412-1423.

Ehrhardt, George, Matteo Marsili, Fernando Vega-Redondo. 2007. "Emergence and Resilience of Social Networks: A General Theoretical Framework". *Annals of Economics and Statistics / Annales d'Économie et de Statistique*, No. 86(Apr. - Jun., 2007), pp. 1-13

England, M., & Artinian, B. 1996. "Salutogenic Psychosocial Nursing Practice". *Journal of Holistic Nursing*, 14(3), 147-195.

Falci, Christina and McNeely, Clea. 2009. "Too Many Friends: Social Integration, Network Cohesion and Adolescent Depressive Symptoms". *Social Forces*, Vol. 87, No. 4: 2031-61

Fingerman, L. Karen, Hay, L. Elizabeth, and Birditt, S. Kira. 2004. "The Best of Ties, the Worst of Ties: Close, Problematic, and Ambivalent Social Relationships". *Journal of Marriage and Family*, Vol. 66, No. 3: 792-808

Garmezy, N., & Rutter, M. (Eds.). 1983. *Stress, Coping and Development in Children*. New York: McGraw- Hill. Times New Roman

Golembiewski, J. 2010. "Start making sense; Applying a salutogenic model to architectural design for psychiatric care". *Facilities*, 28(3).

Golembiewski, J. 2009. "Moving from theory to praxis on the fly; Introducing a salutogenic method to expedite mental healthcare provision". Paper presented at the Australian Rural and Remote Mental Health Symposium. Nature of Living. H Regnery Co.

Greeff, Abraham P. and Stephanus Van Der Merwe. 2004. "Variables Associated with Resilience in Divorced Families" *Social Indicators Research* 68:59-75.

Howard, E. 2006. "The informal social support, well-being, and employment pathways of low-income mothers". In H. Yoshikawa, T. S. Weisner, & E. Lowe (Eds.), *Making it work: Low-wage employment, family life, and child development* (pp. 256 – 272). New York: Russell Sage Foundation.

Kim, Young Choon and Mooweon Rhee. 2010. "The Contingent Effect of Social Networks on Organizational Commitment: A Comparison of Instrumental and Expressive Ties in a Multinational High Technology Company." *Sociological Perspectives* 53:479-502.

Luthar, Suniya S., Dante Cicchetti, and Bronwyn Becker. 2000. "The Construct of Resilience: A Critical Evaluation and Guidelines for Future Work" *Child Development* 71:543-562.

McCubbin, Hamilton I. and Marilyn A. McCubbin. 1988. "Typologies of Resilient Families: Emerging Roles of Social Class and Ethnicity." *Family Relations* 37:247-254.

Murata, Tsuyoshi. 2010. "Chapter 12 Detecting Communities in Social Networks" In *Handbook of Social Network Technologies and Applications*, B. Furht (ed.), Springer Science+Business Media, LLC

Roosa, W. Mark. 2000. "Some Thoughts about Resilience versus Positive Development, Main Effects versus Interactions, and the Value of Resilience". *Child Development* Vol. 71, No. 3, pp. 567-569

Ryan, Rebecca M., Ariel Kalil, and Lindsey Leininger. 2009. “Low-Income Mothers’ Private Safety Nets and Children’s Socio-emotional Well-Being.” *Journal of Marriage and Family* 71: 278-297.

Sherrieb, Kathleen, Fran H. Norris, and Sandro Galea. 2010. “Measuring Capacities for Community Resilience.” *Social Indicators Research* 99:227-247.

Smokowski, Paul R. 1998. “Prevention and Intervention Strategies for Promoting Resilience in Disadvantaged Children.” *The Social Service Review* 72:337-364.

Thilagam, P. Santhi. 2010. “Chapter 29 Applications of Social Network Analysis” In *Handbook of Social Network Technologies and Applications*, B. Furht (ed.), Springer Science+Business Media, LLC

Wang, M. C, Haertel, G. D., & Walberg, H. J. 1997. “Fostering educational resilience in inner-city schools”. In M. C. Wang, G. D. Haertel, & Walberg, H. J(Eds.), *Children and youth* (pp. 119-140). Newbury Park, CA: Sage.

Watts, Duncan J. 2004. "The "New" Science of Networks." *Annual Review of Sociology* 30:243-270.

Wayman, Jeffrey C. 2002. “The Utility of Educational Resilience for Studying Degree Attainment in School Dropouts.” *The Journal of Educational Research* 95:167-178.

Williamson, G Scott & Pearce, Innes Hope. 1966. *Science, Synthesis, and Sanity: An Inquiry Into the Nature of Living*. Chicago: H Regnery co.

Zhang, Mingxin. 2010. “Chapter 1 Social Network Analysis: History, Concepts, and Research” In *Handbook of Social Network Technologies and Applications*, B. Furht (ed.), Springer Science+Business Media, LLC

Table 1 Weighted Descriptive Statistics of variables used in the research (N=9717)

Variables	Frequency/ Minimum	Percentage/ Maximum	Mean	S.D.
State of health compared to 5 years ago				
Much worse	392	4.0		
Somewhat worse	2207	22.7		
The same	4660	48.0		
Somewhat better	1447	14.9		
Much better	1011	10.4		
Factors				
Sex of respondent				
Female	4888	50.3		
Male	4829	49.7		
age on 5 year group				
25 to 29	1370	14.1		
30 to 34	1269	13.1		
35 to 39	1303	13.4		
40 to 44	1441	14.8		
45 to 49	1609	16.6		
50 to 54	1473	15.2		
55 to 59	1251	12.9		
marital status				
single	1615	16.6		
married/com-law	7260	74.7		
not married	842	8.7		
Working status				
No	2160	22.2		
Yes	7557	77.8		
education attainment				
Elementary school/no schooling	88	0.9		
Some secondary/high school	928	9.6		
High school diploma	1384	14.2		
Some trade/technical	309	3.2		
Some community college/CEGEP/nursing	524	5.4		
Some university	495	5.1		
Diploma/certificate from trade/technical	1203	12.4		
Diploma/certificate from community college	2095	21.6		
Bachelor's degree	2013	20.7		
Doctorate/masters/some graduate	678	7.0		
Religion of respondent				
No religion	2424	24.9		
Roman Catholic	4151	42.7		
Protestant	2104	21.7		

Other	1038	10.7		
Urban/Rural indicator				
Urban (CMA/CA)	7593	78.1		
Rural and Small Town(non-CMA/CA)	2124	21.9		
Covariates				
Number of children living in the household	0	4	0.99	1.08
Number of changes experienced in the past 12 months	0	11	2.54	2.26
General state of health	1	5	3.63	1.03
Centered stress level	-2.02	1.98	0.00	0.93
Centered relative size	-7.58	192.42	0.00	10.19
Centered friend size	-6.05	193.95	0.00	9.08
Centered relative strength	-5.55	4.45	0.00	2.58
Centered friend strength	-5.99	4.01	0.00	2.55
Centered network variation	-11.07	6.93	0.00	4.03

Table 2. Bivariate association between stress and network measures and control variables

	Stress level	Relative size	Friend size	Relative strength	Friend strength	Network variation
ANOVA test						
Gender						
Female	0.025	0.224	-0.474	0.470	0.102	0.003
Male	-0.026	-0.227	0.480	-0.475	-0.103	-0.003
P value	**	*	***	***	***	0.943
Marital Status						
single	-0.057	-0.971	0.315	-0.522	0.422	-0.800
married/com-law	0.000	0.382	-0.033	0.108	-0.117	0.232
not married	0.113	-1.431	-0.315	0.072	0.200	-0.466
P value	***	***	0.217	***	***	***
Working Status						
Not working	-0.166	-0.476	-0.560	0.100	-0.096	-0.770
Working	0.047	0.136	0.160	-0.029	0.028	0.220
P value	***	**	***	*	*	***
Religion						
No religion	-0.022	-0.920	0.282	-0.507	0.120	-0.290
Catholic	0.019	-0.116	-0.821	0.305	-0.144	-0.516
Protestant	-0.025	0.982	0.738	-0.044	0.050	0.901
Other	0.026	0.624	1.127	0.055	0.193	0.916
P value	0.138	***	***	***	***	***
Residence						
Urban (CMA/CA)	0.020	-0.261	-0.104	-0.062	0.013	-0.196
Rural (non-CMA/CA)	-0.073	0.933	0.373	0.221	-0.045	0.701
P value	***	***	*	***	0.358	***
Correlation coefficient						
Age	-0.017	-0.008	-.033**	-.074**	-.130**	-.050**
Age square	-.106*	0.011	.034**	-0.009	.020*	-.056**
Education	.097**	0.001	0.015	0.014	.061**	.194**
Number of Children	.093**	.026**	-0.017	.057**	0.016	.113**
Number of Change	.169**	.036**	.041**	.029**	.080**	.214**
General State of Health	-.193**	.043**	.048**	.046**	.058**	.088**
Health compared to 5 years ago	-.202**	0.016	.023*	0.011	.062**	.051**

***Correlation is significant at the 0.001 level (2-tailed).

**Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed).

Table 3 OLS regression coefficients of resilience measure on network measures and control variables

	Model 1		Model 2		Model 3		Model 4	
Variables	b	p	b	p	b	p	b	p
C_Stress			-0.155	0.000	-0.156	0.000	-0.165	0.000
Network variables								
C_Size_R			-0.005	0.001	-0.005	0.002	-0.006	0.001
C_size_F			0.002	0.376	0.000	0.818	0.000	0.969
C_Strength_R			-0.005	0.233	-0.005	0.213	0.004	0.466
C_Strength_F			0.015	0.000	0.015	0.000	0.020	0.000
C_Variation_N			0.007	0.009	0.008	0.002	0.015	0.000
S_Size_R			0.00004	0.000	0.00004	0.001	0.00004	0.001
S_Size_F			-0.00002	0.223				
S_Strength_R			-0.002	0.054	-0.002	0.059	-0.003	0.020
S_Strength_F			0.004	0.004	0.004	0.004	0.003	0.006
S_Variation_N			0.000	0.686				
In_Stress_Size_R					0.000	0.785		
In_Stress_Size_F					0.001	0.321		
In_Stress_Strength_R					0.010	0.007	0.008	0.024
In_Stress_Strength_F					-0.004	0.339		
In_Stress_Variation					-0.004	0.130		
In_Sex_Stress							0.020	0.318
In_Sex_Size_R							0.002	0.329
In_Sex_Size_F							-0.001	0.812
In_Sex_Strength_R							-0.017	0.023
In_Sex_Strength_F							-0.008	0.284
In_Sex_Variation							-0.014	0.005
Control variables								
Female	0.065	0.001	0.079	0.000	0.079	0.000	0.079	0.000
Single	0.044	0.288	0.023	0.643	0.024	0.642	0.019	0.719
Married	-0.061	0.079	-0.065	0.637	-0.064	0.631	-0.066	0.589
Not working	0.010	0.683	-0.031	0.189	-0.034	0.331	-0.032	0.166
No religion	0.005	0.776	0.005	0.800	0.007	0.785	0.008	0.795
Catholic	-0.002	0.881	0.012	0.486	0.014	0.481	0.015	0.452
Protestant	0.040	0.482	0.038	0.577	0.041	0.565	0.038	0.621
Rural	-0.008	0.891	0.006	0.791	0.007	0.382	0.008	0.336
General_H	0.334	0.000	0.315	0.000	0.316	0.000	0.315	0.000
Age	-0.016	0.002	-0.014	0.000	-0.014	0.008	-0.015	0.005
Age square	-0.006	0.027	-0.009	0.002	-0.009	0.003	-0.009	0.002
Education	-0.008	0.034	-0.005	0.000	-0.005	0.191	-0.005	0.165
Child_No	0.035	0.000	-0.024	0.403	-0.024	0.009	-0.025	0.007
Change_N	0.013	0.002	0.017	0.614	0.018	0.000	0.017	0.000
R Square	13.5%		15.7%		15.9%		16.1%	

Figure 1a. Change of Resilience with the Size of Relative Network

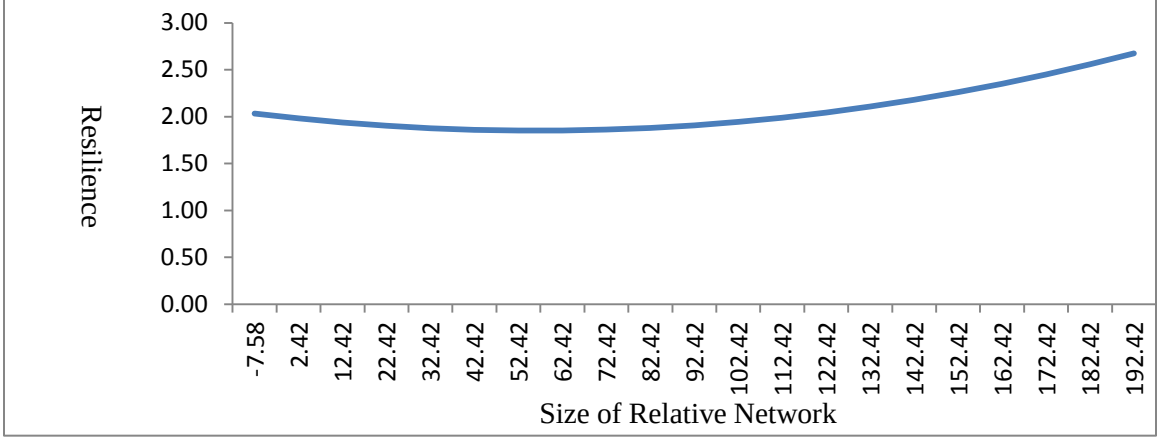


Figure 1b. Change of Resilience with the Strength of Relative network

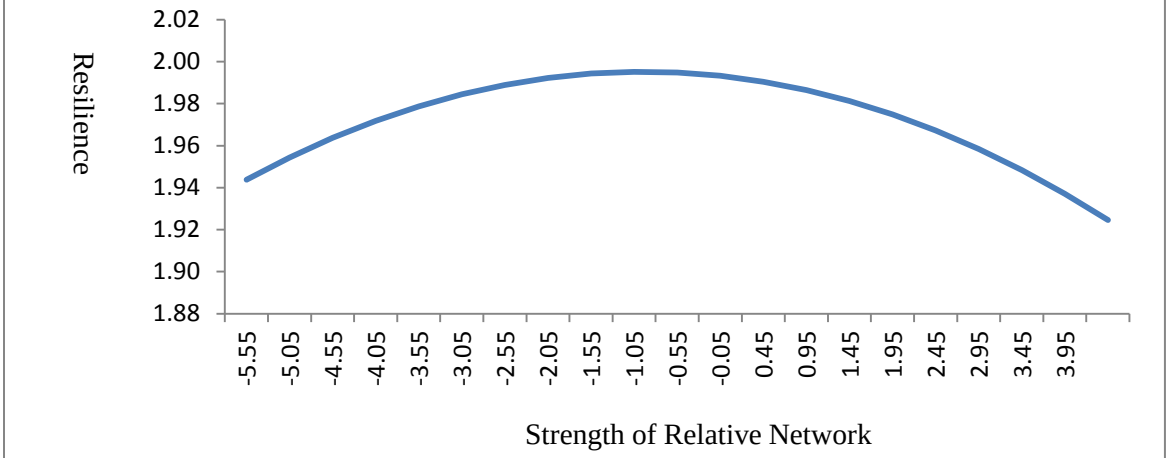


Figure 1c. Change of Resilience with the Strength of Friend Network

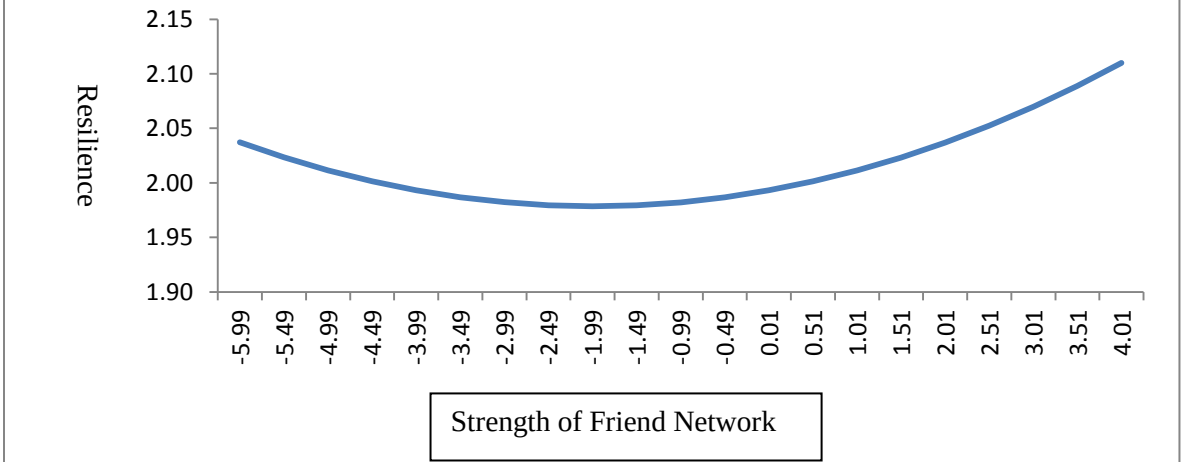


Figure 2a. The relationship between stress level and resilience when the strength of relative network has a value of one SD below the mean, mean, and one SD above the mean

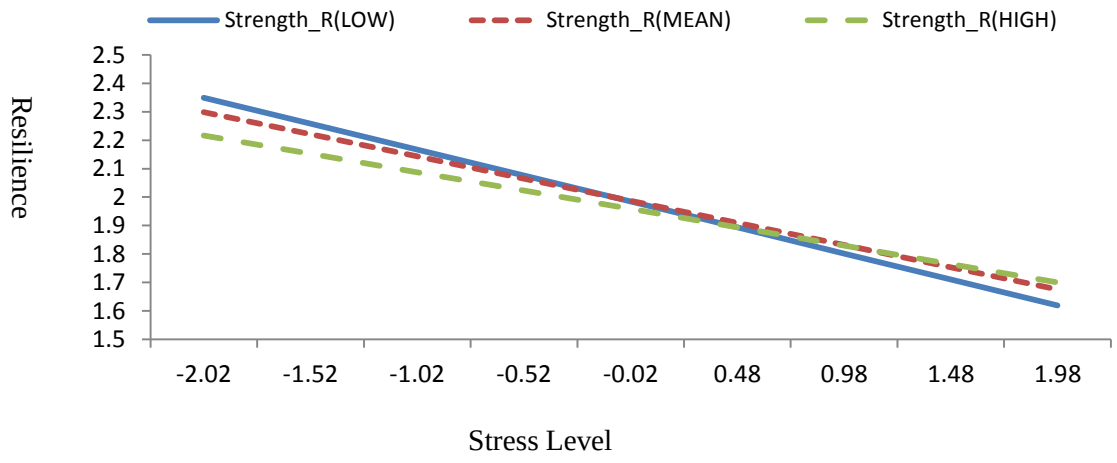


Figure 2b. The relationship between strength of relative network and resilience when stress level has a value of one SD below the mean, mean, and one SD above the mean

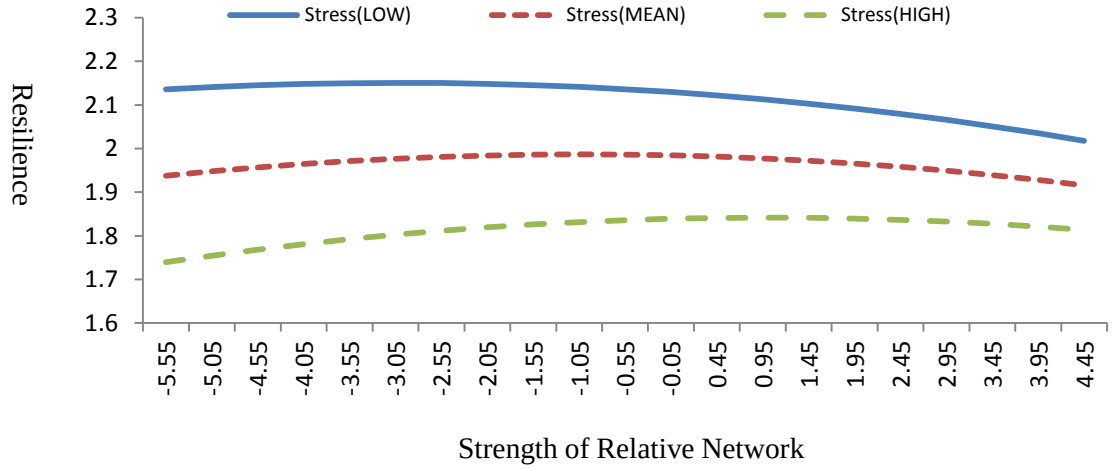


Figure 3a. The relationship between strength of relative network and resilience measure by gender

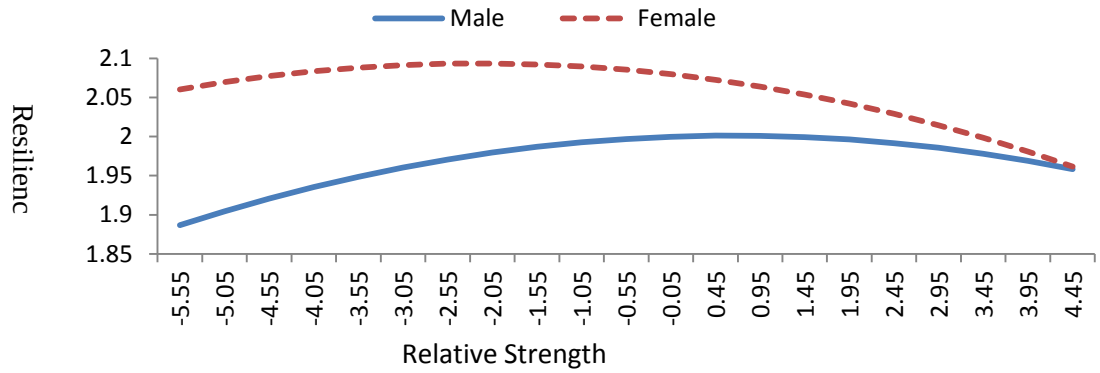
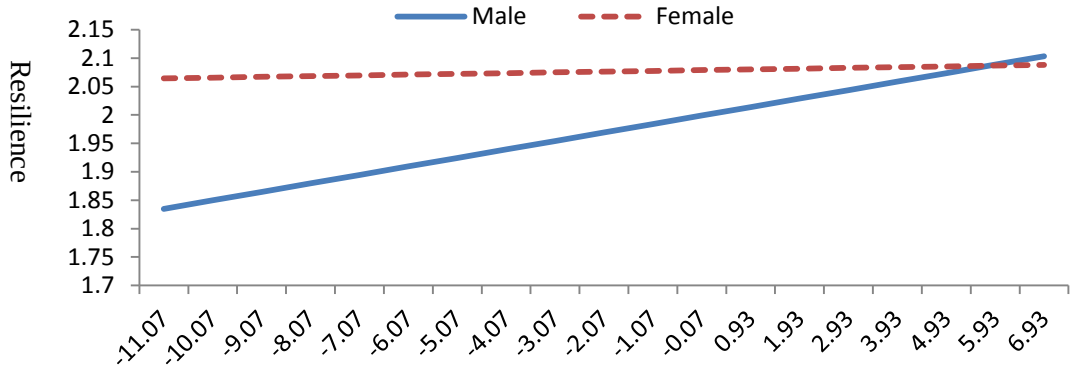
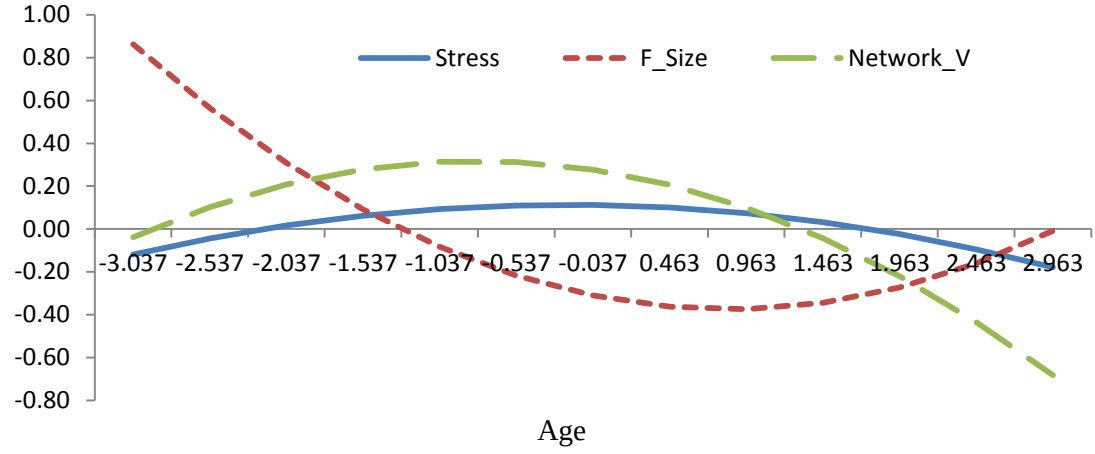


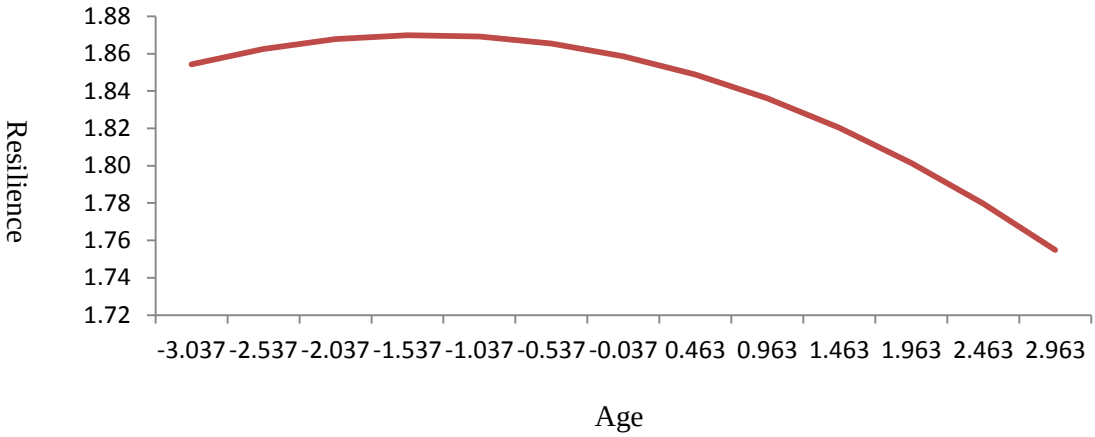
Figure 3b. The relationship between variation of network and resilience measure by gender



Appendix 1. The change of stress level, size of friend network, and variation of network with age



Appendix 2. Change of resilience measure with age



[i] When age is controlled, age square is not significant any more.