

Influence of Kin Network on Maternal and Infant Health and Illness

Nathan Oesch* and RIM Dunbar

Department of Experimental Psychology, University of Oxford, South Parks Road, Oxford OX1 3UD, UK

Abstract

Background: The present study investigated the effects of supportive social network ties on health in a sample of mothers with a young child. The aim of this study was to examine if Liverpool participants having a large supportive network of close relatives reported less cases of illness than participants without such social support.

Methods: A cross-sectional design was employed whereby 74 randomly sampled mothers over the age of 20 with a child 24-36 months completed a questionnaire at twelve monthly time intervals over the course of one year. Multiple logistic regressions were applied to health survey data from participants from Liverpool collected from October 2001 to October 2002.

Results: Respondents living in Liverpool reported decreased illness rates with increased interpersonal contact. A statistically significant reduction in physical illness was observed for mothers and infants that had high contact frequency with close relatives. A statistically significant reduction in physical illness was also found for participants with a large social network of close relatives.

Conclusion: Results confirmed a potentially protective health relation for frequent contact with a large network of close relatives, but showed a less consistent picture for health benefits beyond a certain threshold of more distant relatives. Previous research has shown that social relationships can have a significant impact on psychological wellbeing, health and human disease, and so a greater understanding of social network structure is important to establish the need for preventive care and advice on maintaining important social relationships.

Keywords: Mothers; Women; Social support; Mother-child relations; Child care

Introduction

Social relationships can have a significant impact on psychological wellbeing, health and human disease. For instance, it is well known that individuals with low levels of social support have higher morbidity and mortality rates, especially from cardiovascular disease [1-6]. The precise mechanisms by which social support affects morbidity and mortality are still unclear [3,5,7]. One proposal is that having others to turn to for help or to disclose personal problems may enhance subjective wellbeing directly and may also facilitate coping with stress. Although much of this research has been correlational in nature and is therefore subject to alternative interpretations, the consistency of results across studies of diverse populations has fostered an emerging consensus regarding the benefits of social ties. Indeed, there is evidence that social support appears to be linked with lower ambulatory blood pressure and lower cortisol levels [8]. Further, experimental work has shown that the presence of a friend in a stressful situation is associated with lower blood pressure [8], while embraces from a partner prior to a stressful event increases oxytocin (which acts as an endogenous analgesic) and reduces blood pressure in women [9].

Given the growing body of research on the relationship between psychological wellbeing, health and illness, it is perhaps surprising that this field has not yet been fully integrated into our current understanding of ego-centric social networks. Human social network analysis has recently become a useful and powerful tool for analyzing the collective thoughts and behaviors of large groups of individuals [10]. For example, a wide range of behaviors and psychological states can spread from person to person within social networks, including obesity [11], smoking [12], happiness [13], loneliness [14], and depression [15]. Furthermore, human social networks exhibit a complex organised structure. Ego-centric social networks appear to consist of a series of sub-groupings of personal acquaintanceship arranged in concentric circles [16,17], at the centre of which sits the network "owner"

(conventionally denoted as 'ego'). A social network can be broken down into the following sub-groupings: the support group (core of 3-5 intimates), sympathy group (12-20 close friends or family), the affinity group (45-50 acquaintances), and the active network (150 familiar individuals) [17], these values being successively inclusive. The number 150 appears to be the typical limit on the number of individuals with whom a person can have meaningful relationships [18]. Moreover, it appears that there is a distinct upper limit on both the frequency of contacts and the emotional intensity of the relationship an individual can maintain with each contact in the network: as the number of contacts in the network increases, both the emotional closeness and the frequency of contact decreases [19].

Several studies of friendships and close relationships have distinguished different levels of relationship intimacy without focusing explicitly on network structure [20-22]. For example [20] compared close and casual friendships and found that close friendships showed more interactions during the week, and across a wider range of days, times, and locations than casual friendships. In terms of benefits received, close friends offered more emotional and instrumental support than casual ones. Indeed, the most commonly used classification in these studies is best, close and casual friend [21,22]. Oswald et al. (2004) assessed friendship in terms of different dimensions of friendship maintenance behaviours (positivity, supportiveness, openness and interaction), and

*Corresponding author: Nathan Oesch, Department of Experimental Psychology, University of Oxford South Parks Road, Oxford OX1 3UD, UK, Tel: +44 (0) 7722 564901; E-mail: nathan.oesch@stx.ox.ac.uk

Received: January 29, 2015; Accepted: April 10, 2015; Published: April 13, 2015

Citation: Oesch N, Dunbar RIM (2015) Influence of Kin Network on Maternal and Infant Health and Illness. J Preg Child Health 2: 146. doi:10.4172/2376-127X.1000146

Copyright: © 2015 Oesch N, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

found a clear distinction between higher scoring best friends on the one hand and lower scoring close and casual friends on the other. Rose and Serafica (1986) found that casual friends required less emotional involvement than best or close friends, but were more dependent on opportunities for contact. In summary, studies of human relationships demonstrate that we maintain different kinds of relationships, such as parent-offspring, romantic, and intimate friend relationships, typically involving positive emotion, intimacy, support and interaction [23-26] with most psychological aspects more pronounced in stronger friendships, with best, close and casual constituting a useful graded classification [24,25].

The present study investigated the effects of supportive social ties on the health and wellbeing of mothers of a young child, using a cross-sectional study of a sample of young mothers. Social relations are believed to constitute an especially important resource for women, particularly for expectant mothers or mothers of very young children. Several studies have shown a link between social support and women's health during pregnancy [27,28] as well as a link between social support for mothers and their children's health and wellbeing [29-31]. Although several studies have shown a positive effect of kin network size on morbidity (especially among children) and longevity (especially among men) [32-34], few recent studies have begun to link social support of kin network size specifically to mothers and to their children's health and wellbeing [2]. Moreover, nearly all such research addresses the effects of kin network size in the developing world with much less attention paid to whether a large kin network might affect mothers' health and wellbeing in the developed world. Indeed, mothers in developed nations often receive precious little assistance with the work of parenting, whether in single or joint households [35]. Nevertheless, it is clear that extended family and friends can give substantial emotional and instrumental support to both first-time and experienced mothers. Moreover, given the fact that social networks are in fact highly structured [17], and all relationships are not equal, it is indeed surprising that so little attention has thus far been paid to the role of relatives other than grandmothers in influencing infant and maternal health. Finally, studies have found that a large social network can help boost the immune system [36]. In this study, we focus mainly on kinship networks, including both biological and affinal (in-law related by marriage) kin, as kin provide much of the secondary childcare in many societies [37-39].

This study addresses four main questions. First, what is the relationship between health and contact frequency among the layers of an individual's social network? For the purposes of this study, the close support network was defined as the five most frequently contacted relationships, while the extended support network was defined as the next fifteen most frequently contacted relationships [17]. Accordingly, women who have a strong network of close supportive social ties (i.e. close support network) might be expected to be healthier overall than women with fewer close social ties [27,28]. If this were so, then contact frequency to close relatives would be positively correlated with health and wellbeing. Alternatively, if those who are most active socially are at highest risk of contracting disease simply by virtue of their greater contact with others, then contact frequency with close relatives would then be inversely related to health and wellbeing.

Second, what is the relative impact of close support network interactions versus extended support network interactions on an individual's health and wellbeing? Close support contacts were predicted to be positively related to health and wellbeing, consistent with previous studies [2]. Extended support contacts were predicted to have a positive, but less pronounced effect on wellbeing, due to overall lower contact frequency [17].

Third, what is the impact of close support network and extended support network ties on the health and wellbeing of children, and how do these change as a function of contact frequency among different layers of the network (including childcare providers)? For the purposes of this study, the child's close support network was defined as the five most frequently contacted relationships that provided childcare. For purposes of simplicity, the child's extended support network was defined as in practice equivalent to the maternal extended network with which the child also had repeated exposure. It was predicted that children who have a strong network of close supportive social ties might be expected to be healthier overall than children with fewer close supportive social ties [29,31]. If this were so, then maternal contact frequency to close relatives would be positively related to children's improved health and wellbeing.

Finally, what is the impact of having a large network size on the health and wellbeing of mothers? It was predicted that mothers who have a large network of close relatives might be expected to be healthier than overall than mothers with a smaller network of relatives [2]. If this were so, then size of a mother's network of relatives would be positively related to maternal health and wellbeing.

Method

Participants

The participants were 74 randomly sampled mothers over the age of 20 with a child 24-36 months old from nine low-income neighbourhoods in Liverpool, England. The nine communities corresponded to four geographic areas in Liverpool that had similar household incomes and neighbourhood resources. Data collection was performed by a trained local female interviewer and a local study coordinator in October 2001. The survey included items pertaining to household sanitation and SES/living conditions, marital status, race, educational attainment, social support, quality of partner relationship, and self-rated health. With random sampling, roughly 20 homes were selected from each geographic area. Selected households were excluded if caregivers were absent from homes after the interviewer attempted five visits on different days and times. Mothers then completed a monthly questionnaire on their social contacts and the amount of illness they and their child had experienced over a period of 12 consecutive months. The study protocol was approved by the Research Ethics Committee at the University of Liverpool. Thirteen women were dropped from the analysis due to failure to return all the monthly questionnaires, leaving a sample of 61.

Respondents ranged in age from 23 to 45, with a mean of 34.6 ± 4.66 SD years. Eighty-nine percent were white British, and 76% had a completed A-levels (equivalent to senior year of high school) or better. Eighty-five percent of the mothers' children were white British, 7% being mixed white British. Fifteen percent of the women were full-time housewives, 5% were students, and 80% were employed with a mean income of £375 per month. Most women (91%) lived with a husband or partner, and most families (91%) included at least one biological son or daughter. Thirty-four percent of the women characterised their health as excellent, another 30% characterised it as good, and only 15% reported a specific long-term medical complaint. Consistent with their apparent good health, 84% were non-smokers, 81% reported ten or fewer units of alcohol per week, and 68% reported at least some form of weekly exercise. Mothers reported equally good health for their children: 52% percent characterised their children's health as excellent, and another 37% characterised it as good.

Over the course of the 12 month study, contact stability was high, and contact variability correspondingly low. No women reported the introduction of a new individual, less than 5% reported the loss of an individual (usually a partner or spouse) from the same household, and less than 2% reported any births or deaths in the extended family. Ninety-five percent of the women reported no change to their current occupation, salary, or hours worked per week, nor to those of their partner. All women reported living in their current household an average of 1-3 years or longer. The average geographic proximity to contacts was approximately 30 minutes travel time, with less frequent face-to-face contacts beyond one hour travel time.

Measures

The 30-minute interview dealt with the woman's background, neighbourhood, household and living arrangements, childcare arrangements, frequency of contacts with extended family, frequency of childcare contacts with parents, childcare providers, extended family relationships, health and general wellbeing, and child's health and general wellbeing. Participants then completed a monthly retrospective questionnaire which probed the extent of daily, weekly, and monthly contacts with relatives, partner's relatives, and childcare providers. They were asked to specify whether the contact was made face-to-face, by telephone, or via mail or e-mail. Face-to-face contact was found to be overwhelmingly the most common method of interaction, as interactions via telephone, mail or e-mail made up less than 5% of interactions. For childcare contacts, participants were asked to name specific individuals responsible for childcare, and frequency of child contacts according to the above scale. Finally, participants were asked to complete a 15 item inventory reporting the number of specific ailments they and their child had experienced over the past month, classifying them mild, moderate, or severe in each case. The 15 item inventory listed common illnesses including: backache, headache, migraine, kidney/urinary infection, gynaecological condition, stomach complaints/diarrhoea, high blood pressure, exhaustion, depression/anxiety, stress, eating disorder, cold/flu, asthma, eczema/other skin conditions, and insomnia [40].

Self-rated health

The primary dependent variable, self-rated health, was a woman's response to the question: Would you say your health is excellent, good, fair, or poor? Consistent with previous analyses of this self-rated health measure, we categorized perceived overall health as poor (i.e. severe illness), fair (i.e. moderate illness), and good (i.e. mild illness) vs. excellent health (the reference category). This single question of global self-rated health is robust, independent and among the most frequently used health indices in epidemiological research, even after controlling for a variety of physical, psychosocial, socio-demographic or various clinical factors [41-44]. Self-rated health strongly correlates with objective measures of physical health, functional capacity, and psychological well-being, and is a significant predictor of morbidity, mortality, and health care utilization [45-48]. Furthermore, investigations into the factors related to self-rated health have revealed strong associations with interpersonal relationships, economics and other social factors as among its main determinants [48-51]. In addition, meta-analyses have shown consistent validity and reliability across more than twenty-five different studies from diverse international populations [40]. There appears to be a dose-response relationship, in which each consecutive lower rating of self-reported health corresponds to an associated increase in morbidity and mortality [40]. In most studies, reporting poor health has been associated with odds ratios (ORs) for mortality ranging from

1.5 to 3.0, and it is related to a high number of doctor's visits [40,52,53]. Finally, self-rated health has been widely used in research across Europe and several international countries, including less-developed nations and various age, sex and ethnic groups [42,48,54-57].

Supportive social ties

A variety of approaches to assessing social support have been developed. At the time our survey was developed (during 2001), we conducted a review of available support measures, focusing primarily on functional aspects of support [58,59]. Commonly, a distinction is made between perceived and received support [60,61]. Firstly, we decided to focus on the measurement of the perceived availability of functional support, if needed, as recommended by [62,63], because of our belief that a person's perceptions about available support are most important. Perceived available support is considered to be an entirely cognitive phenomenon, which in turn makes it more stable, universal, and trait-like than actual received support, which is more of an observation of received support [62,63]. The fact that a person does not receive support during a given time period does not mean that the person is unsupported. Received support is confounded with need and may not accurately reflect the amount of support that is available to a person. Moreover, perceived social support has been shown to be more strongly correlated with wellbeing than is received support [64]; therefore, it could be argued that interventions should be focused on increasing perceived support rather than received support.

This study adopted the 6-item scale on emotional and instrumental support, as recommended by Wills and Shinar (2000) [65], from the Older Americans and Resources Inventory (OARS) developed by Fillenbaum and Smyer (1981) [66] in which participants name the people with whom they engage in specific social exchanges. Six questions asked participants to identify the people to whom they turned for two different categories of perceived social support: emotional support (the expression of positive affect, empathetic understanding, and the encouragement of expression of feelings) and instrumental support (the provision of material aid or behavioural assistance) [66]. The authors reported interrater reliability of $r = 0.82$. This type of measure has a record of predictive validity, in that it predicted 30-month mortality in a community sample of 331 participants [67]. The emotional support items asked participants to identify persons with whom they confided personal problems and turned for help when they felt depressed. For example, items included statements such as, "Someone you can confide in and trust not to break your confidence" and "Someone you can talk to if you're feeling low about life in general." The instrumental support items asked participants to identify whom they turned to for help during times of illness or for help with financial difficulties. For example, items included statements such as, "You have to go away for a few days on short notice and need someone to water your plants" and "You're caught up in a doctor's meeting and need someone to pick up your child at the nursery." Following guidelines in Jones and Fischer (1978) [68], up to six names were recorded for each question asked. Virtually no women reported more than six names per question, and the majority reported only 2-3 names per question. For each social support item, a score of 1 was given if the woman named at least one person and a score of 0 was given if no one was named. A composite emotional index score (Figure 1a) and instrumental index score (Figure 1b) were created by summing across these seven items. The composite score thus reflects the number of supportive functions performed by others, rather than the number of others performing these functions.

Though not exhaustive, these questions provide a reasonable representation of the components of social support thought to be most

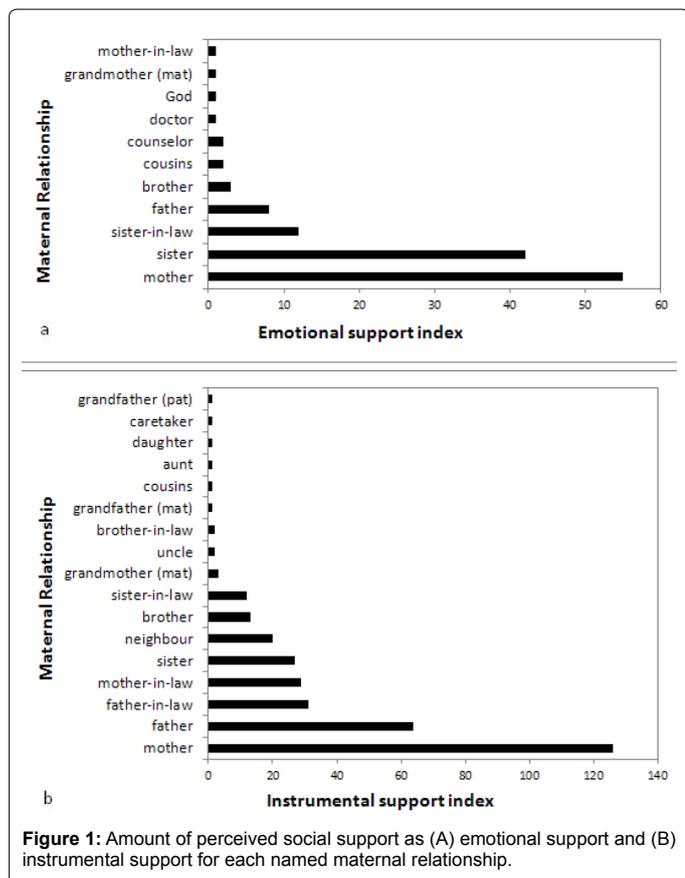


Figure 1: Amount of perceived social support as (A) emotional support and (B) instrumental support for each named maternal relationship.

important [69]. That these questions successfully captured the women’s most important social relations is suggested by the fact that when asked in an open-ended question to name who was most important to them, the most commonly identified contacts were mother (81%), husband/partner (54%), father (51%), sister (36%), brother (14%), neighbours (36%), mother-in-law (26%), father-in-law (28%), sister-in-law (16%), and ex-spouse (7%).

Next, we decided to focus on the measurement of the received availability of functional support, as a second dimension of social contact, which has been found in a recent meta-analysis to have a moderate correlation with perceived support [70]. This second measure assessed frequency of interaction with the people named as sources of support. For each contact, a score of 1 was given for ‘once in the past month’, 2 for ‘2-3 times in the past month’, 3 for ‘about once a week’, 4 for ‘2-3 times per week’, and 5 for ‘daily/every other day’. The close support network was identified as the five most frequently cited kinship contacts: mother, father, sister, mother-in-law, and brother (Figure 2a). The extended support network was identified as the next fifteen most frequently cited kinship contacts: father-in-law, sister-in-law, cousin or nephew, brother-in-law, maternal aunt, maternal grandmother, paternal aunt, affinal cousins and nephews, maternal uncle, maternal grandmother-in-law, paternal uncle, maternal grandfather, paternal aunt-in-law, paternal grandmother, and maternal aunt-in-law (Figure 2b). In sum, the two measures of social support reflect different, complementary dimensions of social contact. One measure reflects the perceived emotional or instrumental supportive roles performed by others, whereas the other focuses on received quantity of contact, defined as the frequency of interaction with supporters.

Control variables

Age and socioeconomic status (SES) have consistently been found to be related to psychological wellbeing and health [71]. On average, the more economically advantaged individuals are, the better their health [71]. These variables have also been shown to be related to adults’ social involvement. Regression analyses were conducted to derive semi-partial correlations between maternal age and joint income (i.e. of the mother and her partner) as control variables for each level of maternal illness, as indicated in Table 1, and child illness, as indicated in Table 2. Joint income was found to be significant

ly related to fewer incidences of maternal illness for each level of illness severity, while age was found to be non-significant for all levels of illness (Table 1). Similarly, joint income was found to be significantly

Variable	r	Mild Illness	Moderate Illness	Severe Illness	Total Illness
Predictor block					
Control variables					
Mother’s age		NS	NS	NS	NS
Joint weekly salary (SES)		-0.184**	-0.196**	-0.221**	-0.296**

Note: **p < .01, *p < .05.

Table 1: Correlation Coefficients Predicting Maternal Illness.

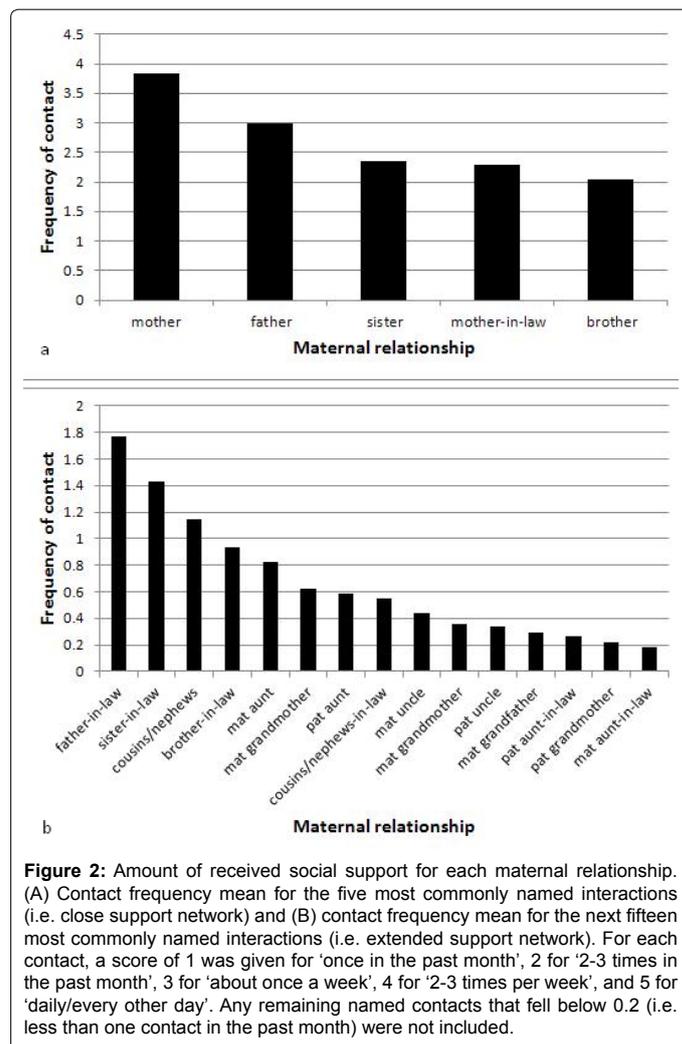


Figure 2: Amount of received social support for each maternal relationship. (A) Contact frequency mean for the five most commonly named interactions (i.e. close support network) and (B) contact frequency mean for the next fifteen most commonly named interactions (i.e. extended support network). For each contact, a score of 1 was given for ‘once in the past month’, 2 for ‘2-3 times in the past month’, 3 for ‘about once a week’, 4 for ‘2-3 times per week’, and 5 for ‘daily/every other day’. Any remaining named contacts that fell below 0.2 (i.e. less than one contact in the past month) were not included.

Variable r	Mild Illness	Moderate Illness	Severe Illness	Total Illness
Predictor block				
Control variables				
Mother's age	NS	NS	NS	NS
Joint weekly salary (SES)	NS	NS	0.096*	0.105*

Note: **p < .01, *p < .05.

Table 2: Correlation Coefficients Predicting Child Illness.

Variable r	Mild Illness	Moderate Illness	Severe Illness	Total Illness
Predictor block				
Close support network				
Mother	-0.221**	NS	-0.096*	-0.203**
Sister	-0.217**	0.203	NS	NS
Mother-in-law	-0.183**	-0.126*	NS	-0.227**
Brother	-0.115*	NS	NS	NS
Extended support network				
Father-in-law	NS	-0.137*	NS	-0.134*
Brother-in-law	-0.164**	-0.167**	NS	-0.225**
Maternal aunt	-0.146**	NS	NS	NS
Maternal grandmother	NS	0.172**	NS	0.171**
Paternal aunt	NS	0.143*	NS	NS
Cousins, nephews, etc.	NS	0.122*	NS	NS
Paternal grandmother	NS	0.295**	NS	NS
Childcare contacts				
Biological parents	-0.121*	NS	NS	-0.118*
Female acquaintances	NS	-0.144*	-0.119*	NS
Brother	NS	NS	0.221**	NS
Sister	NS	0.170**	0.175**	NS
Brother-in-law	0.162*	NS	0.239**	0.202**

Note: **p < .01, *p < .05.

Table 3: Correlation Coefficients Predicting Maternal Illness.

related to greater incidences of child illness for two levels of illness severity, while age was again found to be non-significant at any level of illness (Table 2). For these reasons, joint income or SES was controlled in all analyses that examined relationships between social network variables and health and wellbeing.

Results

Impact of maternal contact frequency and supportive social contacts

Regression analyses were conducted to derive semi-partial correlations between the different support variables and each level of illness, net of the control variable, as indicated in Table 3. Additional chi-square analyses that further examined dichotomised versions of both close support network and extended support network variables revealed systematic patterns with respect to network layers based on kinship relations. Maternal contact frequency with the close support network (i.e. mother, sister, brother and mother-in-law, but not father) was significantly related to fewer instances of mother's mild illness ($\chi^2_8=33.6234$, $p<0.001$). Similarly, maternal contact frequency with the extended support network (i.e. maternal aunt and affinal relatives: brother-in-law and mother-in-law – a close support network contact – but not sister-in-law or father-in-law) was also significantly related to fewer instances of maternal mild illness ($\chi^2_6=27.6312$, $p<0.001$).

However, contact with some members of the extended support network (i.e. affinal relatives: brother-in-law, father-in-law and mother-in-law, but not sister-in-law) was negatively associated with rates of both maternal moderate illness ($\chi^2_6=21.1932$, $p<0.005$), and total illness ($\chi^2_6=24.4122$, $p<0.001$). Thus, these two analyses indicate that frequent contact with close relatives (i.e. close support and extended support network) was associated with greater maternal health and well-being.

Impact of maternal contact frequency and extended support network contacts

Maternal contact frequency with more distant extended support network contacts (i.e. paternal aunt, paternal grandmother, related others including cousins and nephews, maternal grandmother, but not maternal grandfather, paternal uncle, and paternal grandfather) was positively related to greater instances of maternal moderate illness ($\chi^2_8=30.4036$, $p<0.001$). As indicated in Figure 2b, this included individuals whose frequency of contact fell below 0.8 (i.e. less than one contact in the past month). However, it should also be noted that maternal contact frequency with close support network contacts (i.e. sister and brother, as well as brother-in-law – an extended support network contact – but not sister-in-law), for explicit purposes of childcare, was also positively related to greater instances of severe maternal illness ($\chi^2_6=27.6312$, $p<0.001$). Thus, the first analysis indicates that frequent contact with more distant extended support network contacts was associated with poor maternal health and wellbeing, most likely due to increased solicitations for childcare during times of moderate illness. Similarly, the second analysis also indicates that maternal contact frequency with closer relatives (i.e. the close support network), for explicit purposes of childcare, was also related to higher incidence of maternal illness, and also likely due to increased solicitations for childcare during times of severe maternal illness.

Impact of social network family contact frequency on child health

Regression analyses were again conducted to derive semi-partial correlations between the different support variables and each level of illness, net of the two control variables, as shown in Table 4. As indicated in Table 4, in the context of direct child contacts intended explicitly for childcare (i.e. biological parents and sister) contact frequency was significantly related to fewer instances of total child illness ($\chi^2_4=15.2018$, $p<0.005$). Thus, this analysis indicates that frequent and direct child contact with close relatives for purposes of

Variable r	Mild Illness	Moderate Illness	Severe Illness	Total Illness
Predictor block				
Extended support network				
Sister-in-law	-0.104*	NS	NS	NS
Father-in-law	0.143**	NS	NS	0.119*
Maternal aunt-in-law	0.137*	NS	NS	0.195**
Paternal aunt-in-law	NS	NS	NS	0.144*
Paternal grandfather-in-law	NS	NS	NS	0.178*
Childcare contacts				
Biological parents	-0.128**	NS	NS	-0.125**
Sister	NS	NS	NS	-0.144*
Female acquaintances	NS	-0.169**	NS	NS

Note: **p < .01, *p < .05.

Table 4: Correlation Coefficients Predicting Child Illness.

childcare, was related to significant benefits in terms of greater child health and wellbeing. However, maternal contact frequency with more distant relatives (i.e. extended support network: father-in-law and maternal aunt-in-law) was significantly related to greater instances of mild child illness ($\chi^2_4=15.2018$, $p<0.005$) and total child illness ($\chi^2_4=15.2018$, $p<0.005$). Additionally, maternal contact frequency with other more distant relatives (i.e. extended support network: paternal aunt-in-law and paternal grandfather-in-law) was significantly related to greater instances of total child illness ($\chi^2_4=11.9828$, $p<0.025$). Thus, the first analysis indicates that frequent child contact with close support network contacts was associated with greater child health and wellbeing. Conversely, the second analysis suggests that maternal contact frequency with the extended support network, for explicit purposes of childcare, was related to higher incidence of child illness. As with maternal contact with more distant relatives, this was also likely due to increased solicitations for childcare during times of child illness.

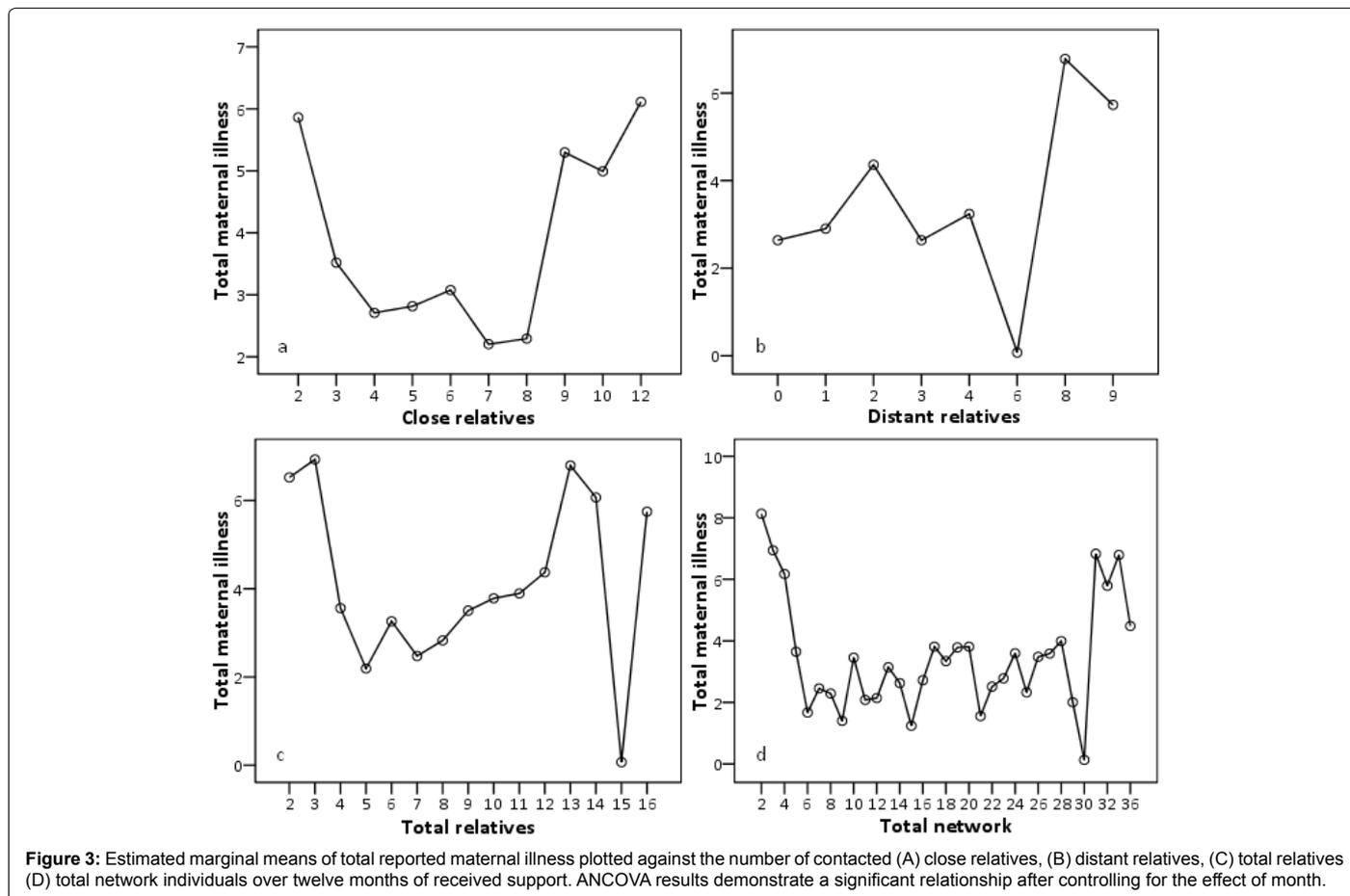
Impact of social network size on maternal illness

Finally, to test the prediction that close support network size influences maternal health and wellbeing, regression analyses examined maternal illness against various dimensions of social network size indexed as the number of different individuals contacted each month. None of the interaction terms were significant and were therefore not reported. However, as illness rates often exhibit a clear annual cycle, an ANOVA tested for the independence of each of the independent variables, and the proposed covariate (month). The main effect for each of the independent variables was not significant, showing that

the mean number of individuals contacted was approximately the same for each month. ANCOVA analyses were then done to test for the relationship between maternal illness and various dimensions of network size, while controlling for the confounding influence of month. ANCOVA [between-subjects factor: close relatives; covariate: month] revealed the predicted main effect of number of close relatives was significantly related to total maternal illness, $F(9, 180) = 3.98$, $p = .000$, $\eta_p^2 = .166$ (Figure 3a), as was the predicted main effect of distant relatives, $F(7, 182) = 3.02$, $p = .005$, $\eta_p^2 = .104$ (Figure 3b), and total relatives, $F(14, 175) = 2.76$, $p = .001$, $\eta_p^2 = .181$ (Figure 3c). ANCOVA [between-subjects factor: total network; covariate: month] results further revealed the predicted main effect of number of total network contacts was significantly related to total maternal illness, $F(32, 157) = 1.88$, $p = .006$, $\eta_p^2 = .277$ (Figure 3d).

Discussion

These results allow us to draw several conclusions regarding the role of close support network and extended support network social ties in the lives of the mothers in this study. First, it has been argued that it is unwise to make assumptions about the quality of a social tie based on knowledge of the role relation. For example, in a cross-sectional study, Rook (1984) found that 38% of those who caused negative social interactions for the respondent were identified as friends, and an additional 36% were identified as kin. Based on these findings, it was concluded that one could not assume that friends and family are uniformly supportive, nor that the effects of problematic social experiences are due to unpleasant encounters with more peripheral



network members, such as neighbours and casual acquaintances. Despite these conclusions, the findings from this cross-sectional study indicate that, over time, close support network interactions (associated with positive health and wellbeing) are more common with more closely related kin, and extended support network interactions (that increase in frequency with maternal illness) are more common among more distantly related kin and unrelated others.

Second, close support network interactions have more potent effects on wellbeing than extended support network interactions. The regression analyses indicated that close support network interactions with others were more consistently and strongly related to health and wellbeing than were extended support network ties. This pattern held even when controlling for demographic characteristics, including maternal age and socioeconomic status. Supportive ties with others were positively related to health and wellbeing only when they involved closely related kin and partner's close kin (i.e. close support network and some extended support network contacts). Conversely, and perhaps counterintuitively, it was also found that maternal contact frequency with close relatives (including brothers, sisters and sisters-in-law) for purposes of childcare was related to higher incidence of maternal illness. However, the most likely explanation for this finding is that solicitations for childcare were simply greater during times of maternal illness.

It is possible that negative social interactions or perhaps the transmission of communicable disease, was the source of the relationship between maternal illness and frequency of contact. However, this interpretation seems unlikely for three reasons. First, the pattern of illness-associated relationships, based on kinship and decreased frequency of contact as shown in Figure 2b, make it highly unlikely that such a trend would continue consistently over a twelve-month period if such associations could be attributed to infectious disease. Second, contacts were made via three methods: face-to-face, telephone, and mail or e-mail. Accordingly, if illness associated contacts were due to infectious disease, one might expect a higher incidence of face-to-face contacts among illness associated interactions, and a correspondingly lower incidence of face-to-face contacts among health-associated interactions. However, there was very little evidence of such a relationship; on the contrary, face-to-face contact was found to be overwhelmingly the most common method of interaction associated with health-associated relationships, while no consistent method of contact was noted for illness-associated relationships. Third, the vast majority of the 15 item inventory sicknesses included commonly associated stress-related illnesses: backache, headache, migraine, stomach complaints/diarrhoea, high blood pressure, exhaustion, depression/anxiety, stress, eating disorder, cold/flu, and insomnia. Accordingly, it seems unlikely that air-borne or blood-borne pathogens were the unique causes of disease, as opposed to unknown sources of unrelated life stressors. A more plausible explanation is that the relationship between illness and frequency of contact with more distant relatives reflects the fact that, as illness becomes more severe, mothers are obliged to solicit childcare from further afield, and hence that most of their contacts with the extended support network mainly occurred only at these times. As such, this draws attention to the importance of having a relatively large and geographically accessible extended support network that can be called on for childcare support. Finally, as noted above, it is possible that negative social interactions [72], were the source of the relationship between maternal illness and frequency of contact. This alternative interpretation suggests that problematic interactions caused the positive associations with maternal illness. Yet if the women's increased illness occurred because of troublesome or negative social interactions, then

it seems unlikely they would have wanted to maintain such social ties consistently over a 12 month period, especially in light of the fact that the majority of these contacts were contacted less frequently and were more distantly related. The results showed, however, that women with increased incidence of illness had as many supportive and close social ties as other women. In general, there was little evidence that women with increased incidence of illness had more problematic or negative social ties or were otherwise remarkably different from other women. For these reasons, it seems plausible that the significant relationships observed in the regression analyses reflect a direct effect of increased contact associated with positive health and wellbeing among more closely related kin, and an increase in frequency of maternal illness among more distantly related kin and unrelated others.

Third, children that received childcare experienced positive effects on health and wellbeing when ties involved closely related kin, including the mother's parents and female siblings. Based on the results for maternal contacts and health, where health benefits were associated with closely related kin including brothers, sisters, mothers, and maternal aunts, we might predict a similar relatedness pattern for childcare contacts and health. However, given that these children were 2-3 years of age, it is probably more reasonable to assume that what constitutes a viable close support network and childcare group at this age of development is limited to parents and those who can assume a similar familiar role to parents. These results underscore the importance of assessing the specific role relations of social ties, especially kin relations, when attempting to understand their potential health benefits [73]. Moreover, these results tend to support previous findings concerning the positive role of adult caretakers in the family, most notably the Newcastle Thousand Families study in industrial Newcastle [33,74] as well as families in rural Dominica [32,34,75].

Finally, the results of this study further support previous findings which indicate the importance of a large support network for improved health and wellbeing [2,32-34]. However, these results also point to a subtler interpretation, in that there is an optimum number between 3-6 relatives (i.e. the support group) highly associated with greatest health benefits, and contacts beyond 30-40 individuals (i.e. approaching the affinity group) associated with increased illness (Figure 3d). Indeed, these results suggest increased illness may be a direct result not of negative social interactions [72], but rather of ecological immunosuppression due to the energetically costly activity of maintaining increasing numbers of social contacts [76], as well as increasing cognitive constraints, as the number of emotionally close relationships in the network decrease [19].

Our results should be considered preliminary because our study included several important limitations. First, a major limitation was the cross-sectional nature of the survey, which makes it difficult to establish causality of the associations between self-rated health and social network contacts. We used a convenience sample that was restricted to one city and solely included mothers of young children. Second, we relied on a self-administered self-report questionnaire for measuring both psychological wellbeing and the physical symptoms that were used to validate self-reported health. Therefore, like any other questionnaire-based study, the subjects' answers may have been affected by various kinds of bias such as social desirability, expectations and relative deprivation, i.e. well-known confounders in sociological and psychological measurement. Future studies should use other measures of wellbeing and health, including more objective measures such as physiological measures of immune function and/or stress to complement the direct relationships reported by the results. Third,

although the response rate was reasonable, the overall sample size was relatively modest reducing the power to detect significant differences. It is further unclear how well these findings may generalise to men and fathers, or to other more affluent communities in the developed world. For instance, it is conceivable that mothers may be more susceptible to illness when caring for small children (whom are often prone to illness through childcare), as compared to single men without children. In this case, socially supportive ties may be in fact more beneficial to mothers than to single men. Lastly, as our analyses focused primarily on close and distant kinship relationships, and less on close and distant friendships, we cannot report with confidence that our analyses encompass a complete social network.

The results of this study support the conclusion that close support and extended support networks consist of those relationships to which we turn for both perceived and received support with positive consequences for illness and wellbeing. This suggests that the distinction between intimates and close friends and family lies in a balance in the distribution of costs and benefits with reference to their respective functional outcomes [77]. Intimates identify a set of individuals who provide close emotional and instrumental support that modulates stress and emotional well-being, while enabling us to interface with the wider social environment. In this respect, they resemble the kinds of relationships identified in Fredrickson's (2004) [78] broaden-and-build theory of positive emotions: relationships exist to nurture positive emotions that in turn provide a social and psychological environment within which individuals can not only survive better as individuals, but also cooperate more effectively as functional groups. Such relationships allow us to reduce stress by their reassuring presence and, at least among adults, the promise of intervention in conflicts by active support, as has been documented in primates [79-81]. Among humans, there are similarly striking effects of network membership on well-being: Fowler and Christakis (2008) [13], for example, have shown that the state of happiness of one's close friends, and even friends-of-friends, can prospectively influence one's own happiness.

The relationship between positive social support in health and stress management has been widely studied, and the importance of social support has been established [82]. Much of the current enthusiasm for research on social support derives from the expectation that the findings will provide information for the design of social support interventions that enhance health and wellbeing. Most discussions of social network interventions focus on the need to facilitate formation of supportive social interactions. However, few studies thus far have analysed specific role relationships, especially kin support networks, or looked at the impact of close support network and extended support network ties within these same kin networks. On the basis of the findings in our investigation, we encourage health professionals and other investigators to pay additional attention to the size of kin networks and the different roles of close versus extended support network ties. Better understanding of the effects of the positive aspects of large kin networks may help clarify some of the complexities in the relationship between social support and wellbeing and may also provide additional direction for the development of interventions to enhance the benefits of interpersonal relationships.

Conflict of Interest Statement

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Acknowledgments

We would like to thank the European Research Council (Grant Number 295663) for its funding support during the writing of this article, and Becky Hoare for organizing the sampling and managing the data collection.

References

1. Berkman LF, Glass T, Brissette I, Seeman TE (2000) From social integration to health: Durkheim in the new millennium. *SocSci Med* 51: 843-857.
2. House JS, Landis KR, Umberson D (1988) Social relationships and health. *Science* 241: 540-545.
3. Reblin M, Uchino BN (2008) Social and emotional support and its implication for health. *Curr Opin Psychiatry* 21: 201-205.
4. Smith KP, Christakis NA (2008) Social networks and health. *Annual Review of Sociology* 34: 405-429.
5. Uchino BN (2006) Social support and health: a review of physiological processes potentially underlying links to disease outcomes. *J Behav Med* 29: 377-387.
6. Uchino BN, Cacioppo JT, Kiecolt-Glaser JK (1996) The relationship between social support and physiological processes: a review with emphasis on underlying mechanisms and implications for health. *Psychol Bull* 119: 488-531.
7. House JS (2001) Social isolation kills, but how and why? *Psychosom Med* 63: 273-274.
8. Uchino BN, Berg CA, Smith TW, Pearce G, Skinner M (2006) Age-related differences in ambulatory blood pressure reactivity during stress: Evidence for greater blood pressure reactivity with age. *Psychology and Aging* 21: 231-239.
9. Light KC, Grewen KM, Amico JA (2005) More frequent partner hugs and higher oxytocin levels are linked to lower blood pressure and heart rate in premenopausal women. *Biological Psychology* 69: 5-21.
10. Lazer D, Pentland A, Adamic L, Aral S, Barabasi AL, et al. (2009) Social science. *Computational social science. Science* 323: 721-723.
11. Christakis NA, Fowler JH (2007) The spread of obesity in a large social network over 32 years. *New England Journal of Medicine* 357: 370-379.
12. Christakis NA, Fowler JH (2008) The collective dynamics of smoking in a large social network. *N Engl J Med* 358: 2249-2258.
13. Fowler JH, Christakis NA (2008) Dynamic spread of happiness in a large social network: longitudinal analysis over 20 years in the Framingham Heart Study. *BMJ* 337: a2338.
14. Cacioppo JT, Fowler JH, Christakis NA (2009) Alone in the crowd: the structure and spread of loneliness in a large social network. *J Pers Soc Psychol* 97: 977-991.
15. Rosenquist JN, Fowler JH, Christakis NA (2011) Social network determinants of depression. *Mol Psychiatry* 16: 273-281.
16. Hill RA, Dunbar RIM (2003) Social network size in humans. *Human Nature* 14: 53-72.
17. Zhou WX, Sornette D, Hill RA, Dunbar RI (2005) Discrete hierarchical organization of social group sizes. *Proc Biol Sci* 272: 439-444.
18. Dunbar RIM (1992) Neocortex size as a constraint on group size in primates. *Journal of Human Evolution* 22: 469-493.
19. Roberts SGB, Dunbar RIM, Pollet TV, Kuppens T (2009) Exploring variation in active network size: Constraints and ego characteristics. *Social Networks* 31: 138-146.
20. Hays RB (1989). The day-to-day functioning of close versus casual friendships. *Journal of Social and Personal Relationships* 6: 21-37.
21. Oswald DL, Clark EM, Kelly CM (2004) Friendship maintenance: an analysis of individual and dyad behaviours. *Journal of Social and Clinical Psychology* 23: 413-441.
22. Rose S, Serafica F (1986) Keeping and ending casual, close and best friendships. *Journal of Social and Personal Relationships* 3: 275-288.
23. Berscheid E (1994) Interpersonal relationships. *Annual Review of Psychology* 45: 79-129.
24. Brown SL, Brown RM (2006) Selective investment theory: recasting the functional significance of close relationships. *Psychological Inquiry* 17: 1-29.

25. Dainton M, Zelle E, Langan E (2003) Maintaining friendships throughout the lifespan. In: Canary D, Dainton M (Eds) *Maintaining Relationships Through Communication* (pp. 79-102). Mahwah, NJ: Lawrence Erlbaum Associates.
26. Kelley HH, Berscheid E, Christensen A, Harvey JH, Huston TL, Levinger G, McClintock E, Peplau LA, Peterson DR (1983) *Close Relationships*. New York: Freeman.
27. Collins NL, Dunkel-Schetter C, Lobel M, Scrimshaw SC (1993) Social support in pregnancy: psychosocial correlates of birth outcomes and postpartum depression. *J Pers Soc Psychol* 65: 1243-1258.
28. Harley K, Eskenazi B (2006) Time in the United States, social support and health behaviors during pregnancy among women of Mexican descent. *Soc Sci Med* 62: 3048-3061.
29. Adams AM, Madhavan S, Simon D (2002) Women's social networks and child survival in Mali. *Soc Sci Med* 54: 165-178.
30. deCarvalhoes MABL, D'AquinoBenecio MH, Barros AJD (2005) Social support and infant malnutrition: a case-control study in an urban area of southeastern Brazil. *British Journal of Nutrition* 94: 383-389.
31. Kana'iaupuni SM, Donato KM, Thompson-Colon T, Stainbeck M (2005) Counting on kin: social networks, social support, and child health status. *Social Forces* 83: 1137-1164.
32. Flinn MV, England BG (1995). Childhood stress and family environment. *Current Anthropology* 36: 854-866.
33. Spence J (1954) *One Thousand Families in Newcastle*. Oxford: Oxford University Press.
34. Werner EE (1989) High-risk children in young adulthood: a longitudinal study from birth to 32 years. *Am J Orthopsychiatry* 59: 72-81.
35. Arendell T (2000) Conceiving and investigating motherhood: the decade's scholarship. *Journal of Marriage and Family* 62: 1192-1207.
36. Kaplan RH, Toshima MT (1990) The functional effects of social relationships on chronic illness and disability. In: Sarason BR (Ed), *Social Support: An Interactional View* (pp. 427-453). New York: Wiley.
37. Burton LM (1990) Teenage childbearing as an alternative life-course strategy in multigeneration black families. *Hum Nat* 1: 123-143.
38. Hames R (1988) The allocation of parental care among the Ye'kwana. In: Betzig L, Borgerhoff Mulder M, Turke P (Eds) *Human Reproductive Behaviour: A Darwinian Perspective* (pp. 237-252). Cambridge: Cambridge University Press.
39. Ivey P (2000) Cooperative reproduction in Ituri Forest hunter-gatherers: who cares for Efe infants? *Current Anthropology* 41: 856-866.
40. Idler EL, Benyamini Y (1997) Self-rated health and mortality: a review of twenty-seven community studies. *J Health Soc Behav* 38: 21-37.
41. Benjamins MR, Hummer RA, Eberstein IW, Nam CB (2004) Self-reported health and adult mortality risk: an analysis of cause-specific mortality. *Soc Sci Med* 59: 1297-1306.
42. Eriksson I, Undén A-L, Elofsson S (2001) Self-rated health. Comparisons between three different measures. Results from a population study. *International Journal of Epidemiology* 30: 326-333.
43. Fayers P (2005) *Assessing Quality of Life in Clinical Trials: Methods and Practice*. Oxford: Oxford University Press.
44. Quesnel-Vallée A (2007) Self-rated health: caught in the crossfire of the quest for 'true' health? *Int J Epidemiol* 36: 1161-1164.
45. Dubikaytis T, Härkänen T, Regushevskaya E, Hemminki E, Haavio-Mannila E, Laanpere M, Kuznetsova O, Koskinen S (2014) Socioeconomic differences in self-rated health among women: a comparison of St. Petersburg to Estonia and Finland. *International Journal for Equity in Health* 13: 1-11.
46. Mossey JM, Shapiro E (1982) Self-rated health: a predictor of mortality among the elderly. *Am J Public Health* 72: 800-808.
47. Snead CM (2007) Self-rated health. In: Ritzer G (Ed) *Blackwell Encyclopedia of Sociology* (pp. 31-33), Oxford: Wiley-Blackwell.
48. Wu S, Wang R, Zhao Y, Ma X, Wu M, et al. (2013) The relationship between self-rated health and objective health status: a population-based study. *BMC Public Health* 13: 320.
49. Kawachi I, Kennedy BP, Glass R (1999) Social capital and self-rated health: a contextual analysis. *Am J Public Health* 89: 1187-1193.
50. Lindström M (2009) Marital status, social capital, material conditions and self-rated health: a population-based study. *Health Policy* 93: 172-179.
51. Mansyur C, Amick BC, Harrist RB, Franzini L (2008) Social capital, income inequality, and self-rated health in 45 countries. *Soc Sci Med* 66: 43-56.
52. Idler EL, Angel RJ (1990) Self-rated health and mortality in the NHANES-I Epidemiologic Follow-up Study. *Am J Public Health* 80: 446-452.
53. McGee DL, Liao Y, Cao G, Cooper RS (1999) Self-reported health status and mortality in a multiethnic US cohort. *Am J Epidemiol* 149: 41-46.
54. Abdulrahim S, El Asmar K (2012) Is self-rated health a valid measure to use in social inequities and health research? Evidence from the PAFAM women's data in six Arab countries. *Int J Equity Health* 11: 53.
55. Khawaja M, Mowafi M (2007) Types of cultural capital and self-rated health among disadvantaged women in outer Beirut, Lebanon. *Scand J Public Health* 35: 475-480.
56. Pärna K, Ringmets I (2010) Comparison of socioeconomic differences in self-perceived health in Estonia and Finland. *Scand J Public Health* 38: 129-134.
57. Szwarcwald CL, Souza-Júnior PR, Esteves MA, Damascena GN, Viacava F (2005) Socio-demographic determinants of self-rated health in Brazil. *Cad Saude Publica* 21 Suppl: 54-64.
58. Langford CP, Bowsher J, Maloney JP, Lillis PP (1997) Social support: a conceptual analysis. *J Adv Nurs* 25: 95-100.
59. Wills TA (1991) Social support and interpersonal relationships. In: Clark MS (Ed), *Review of Personality and Social Psychology: Prosocial Behavior* 12 (pp. 265-289), Newbury Park, CA: Sage.
60. Barrera M (1986) Distinctions between social support concepts, measures, and models. *American Journal of Community Psychology* 14: 413-445.
61. Taylor SE (2011) Social support: a review. In: Friedman MS (Ed), *The Handbook of Health Psychology* (pp. 189-214), New York, NY: Oxford University Press.
62. Dunkel-Schetter C, Bennett TL (1990) Differentiating the cognitive and behavioral aspects of social support. In: Sarason BR, Sarason IG, Pierce GR (Eds) *Social Support: An Interactional View* (pp. 267-296). Wiley: New York.
63. Lahey B, Drew JB (1997) A social-cognitive perspective on social support. In: Pierce GR, Lahey B, Sarason IG, Sarason BR (Eds), *Sourcebook of Social Support and Personality* (pp. 107-140). New York: Plenum Press.
64. Wethington E, Kessler RC (1986) Perceived support, received support, and adjustment to stressful life events. *J Health Soc Behav* 27: 78-89.
65. Wills TA, Shinar O (2000) Measuring perceived and received social support. In: Cohen S, Underwood L, Gottlieb, BH (Eds) *Social Support Measurement and Intervention: a Guide for Health and Social Scientists* (pp. 86-135), Oxford: Oxford University Press.
66. Fillenbaum GG, Smyer MA (1981) The development, validity, and reliability of the OARS multidimensional functional assessment questionnaire. *J Gerontol* 36: 428-434.
67. Blazer DG (1982) Social support and mortality in an elderly community population. *Am J Epidemiol* 115: 684-694.
68. Jones LM, Fischer CS (1978) Studying egocentric networks by mass survey (Working Paper No. 281). Institute of Urban and regional Development, University of California, Berkeley.
69. House JS (1981) *Work Stress and Social Support*. Reading, MA: Addison-Wesley.
70. Haber MG, Cohen JL, Lucas T, Baltes BB (2007). The relationship between self-reported received and perceived social support: A meta-analytic review. *American Journal of Community Psychology* 39: 133-144.
71. Adler NE, Ostrove JM (1999) Socioeconomic status and health: what we know and what we don't. *Ann N Y Acad Sci* 896: 3-15.
72. Rook KS (1984) The negative side of social interaction: impact on psychological well-being. *J Pers Soc Psychol* 46: 1097-1108.
73. Grayson DK (1993). Differential mortality and the Donner party disaster. *Evolutionary Anthropology* 2: 151-159.
74. Parker L, Lamont DW, Wright CM, Cohen MA, Alberti KG, et al. (1999) Mothering skills and health in infancy: the Thousand Families study revisited. *Lancet* 353: 1151-1152.

-
75. Berkman LF (1984) Assessing the physical health effects of social networks and social support. *Annu Rev Public Health* 5: 413-432.
76. Segerstrom SC1 (2008) Social networks and immunosuppression during stress: relationship conflict or energy conservation? *Brain Behav Immun* 22: 279-284.
77. Sutcliffe A, Dunbar R, Binder J, Arrow H (2012) Relationships and the social brain: integrating psychological and evolutionary perspectives. *Br J Psychol* 103: 149-168.
78. Fredrickson BL1 (2004) The broaden-and-build theory of positive emotions. *Philos Trans R Soc Lond B BiolSci* 359: 1367-1378.
79. Crockford C, Wittig RM, Whitten PL, Seyfarth RM, Cheney DL (2008) Social stressors and coping mechanisms in wild female baboons (*Papiohamadryasursinus*). *Horm Behav* 53: 254-265.
80. Wittig RM, Crockford C, Lehmann J, Whitten PL, Seyfarth RM, et al. (2008) Focused grooming networks and stress alleviation in wild female baboons. *Horm Behav* 54: 170-177.
81. Dunbar RIM (2010) Brain and behaviour in primate evolution. In: Kappeler PH, Silk J (Eds) *Mind the Gap: Tracing the Origins of Human Universals* (pp. 315-330). Berlin: Springer.
82. Cohen S, Gottlieb BH, Underwood LG (2000) Social relationships and health. In: Cohen S, Underwood L, Gottlieb BH (Eds) *Social Support Measurement and Intervention: A Guide for Health and Social Scientists* (pp. 3-28). Oxford: Oxford University Press.