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SOCIAL TIES AND MORTALITY IN EVANS COUNTY, GEORGIA

APPENDIX

Structure of the Berkman Social Network Index

Procedure for construction of an Evans County surrogate

I. PURPOSE OF EVANS COUNTY SOCIAL NETWORK INDEX

 In attempting to replicate Berkman and Syme's basic finding of lower mortality risks for men and women having a higher level of social and community ties, we sought as close a replication as possible of their social network index. Our reasoning was that if one were attempting to replicate a relationship reported for a chemical substance that had not yet been fully characterized, one would repeat the methods for extraction, separation, and so forth in order to duplicate as closely as possible the procedures in the original report. Applying this analogy to the social network index, we should therefore repeat the exact method of constructing the index. Unfortunately, the Evans County interview did not contain identical items for all of those entering the Berkman index. We therefore chose the most comparable items and derived the most comparable index. We avoided experimenting with different indexes, at first, since we wanted to carry out our statistical test of hypothesis without adjusting the nominal significance level for multiple tests. Since the index constructed by Berkman and Syme represented a summary of findings observed for individual variables, we carried out our attempted replication *a priori* rather than following examination of relationships between individual items and survival.

II. DISCUSSION OF BERKMAN SOCIAL NETWORK INDEX

 The Berkman Social Network Index derives from three groups of items in the 1965 Human Population Laboratory Questionnaire. These item categories are (1) marital status, (2) friends and relatives, and (3) church and group membership. These categories are organized into four conceptual components: marital status, contact with friends and relatives, church group membership, and group membership. The construction of each component and the underlying concepts are described below.

(1) Marital status

The marital status component is a dichotomous variable: not married (includes single, separated, divorced, and widowed) versus married.

(2) Contacts with Friends and Relatives

Three variables contributed to this component: the number of close friends, the number of close relatives, and the total number of close friends and relatives who are seen at least once a month. The response choices for each of these items were: "none", "1 or 2", "3 to 5", "6 to 9", or "10 or more".

Number of close friends and number of close relatives are combined to form the first part of this component. Equal weight is given to each variable. Linear combinations of the close friend and close relative values produce an overall index. The lowest index value includes combinations ranging from 0 friends *and* relatives, to 0 friends *or* relatives plus 3 to 5 relatives *or* friends. A person in the lowest category of contacts with friends and relatives thus could have a total of 5 close friends or relatives. This total could exceed the smallest number of friends and relatives in the next lowest category.

The Relatives and Friends Score can be reproduced by combining the midpoint values of the response choices to the individual questionnaire items. The four values of the Relatives and Friends Score then correspond to the following ranges for the variables "number of close friends" and "number of close relatives":

Mathematical structure underlying construction of the Sociability Score

 Relatives and Friends Range of

 Score value midpoint sums

 1 0 – 4

 2 5.5 - 9.0

 3 10 – 15

 4 16+ - 17.5+

(In the last category the lowest value is actually "3-5" plus "10+", for which the sum of the midpoints could be as low as 14.) For example, if number of close friends is 0 and number of close relatives is at most "3-5", then the sum of the midpoint values is 4 and the Relatives and Friends Score is 1. If number of close friends is "3-5" and number of close relatives is "6-9", then the sum of the midpoint values is 4 + 7.5 = 11.5 and the Relatives and Friends Score is 3.

Berkman and Syme state that these "cutting points were chosen to "coincide with 'breaks' in the array of ranges and to produce as even a distribution as possible" [Berkman, 1977 (dissertation), page 271, Appendix B).

The Friends and Relatives score was combined with the number of close friends and relatives seen at least once a month. The resulting Sociability Score had three categories (1, low sociability to 3, high sociability) as follows:

Derivation of the BSNI Sociability Score

Sociability Relatives and Number of Friends and

Score value Friends Score Relatives Seen in a Month

1. Low 1 Any response

2. Medium 2-3 Any response

OR 4 3-5 or fewer

3. High 4 6-9 or more.

 The Sociability score seems to emphasize number of friends and relatives, rather than frequency of these contacts. A high sociability score results only if a person falls in the highest category of the friends and relatives score (i.e., has more than about 14 friends and relatives and sees at least six times monthly. An intermediate form of the Sociability Score has five levels, which are collapsed into the above three levels.

(3) Church group

This component is an indicator variable based on whether the respondent reported belonging to a church group. Presumably the variable represents an effect of church *group membership* rather than the religion, church membership, or church attendance, *per se*. In Berkman's dissertation and in the published report, this variable is alternately referred to as "church membership" and "church group membership". Dr. Berkman has indicated (personal communication, 1983) that she believes respondents may have responded to the question as if church membership in general were the subject, rather than specifically church *group* membership.

(4) Group Membership

This component consists of an affirmative response to the question:

"Do you belong to any of these groups?"

"A social or recreational group?; A labor union, commercial group, professional organization?; A group concerned with children? (PTA, Boy Scout); A group concerned with community betterment, charity, or service?; Any other group?"

The group membership component takes the value of zero (no affirmative responses) or one (one or more affirmative responses). No distinction is made between membership in one (non-church) group or membership in more than one, regardless of the number or type of group (other than church groups).

Final Construction of the Social Network Index

These four components enter the Social Network Index in two steps. First, an Index of Intimate Contacts is formed from components 1 (marital status) and 2 (contacts with friends and relatives). The combination is not precisely additive: for married individuals, the intimate contacts index score equals the sociability score; for unmarried individuals, the intimate contacts index score is one value lower than the sociability score value.

Different combinations of intimate contacts, church membership (component 3) and group membership (component 4) scores form the Social Network Index, whose values range from 1(low) to 4(high). A "low" social network index score results only when intimate contacts, church membership, and group membership were low or absent. A "medium" social network score could result from four different combinations of these components; a "medium high" score resulted from two different combinations, and a "high" score was obtained from five different combinations. With one exception, only "high" intimate contact scorers receive a "high" social network index (regardless of church or group membership). If a person scored "high" on both church and group membership, and "medium" on intimate contacts, he/she rated "high" on the social network index.

III. ALGEBRAIC ANALYSIS OF THE BERKMAN SOCIAL NETWORK INDEX

The weightings involved in the construction of the overall index were based on theoretical, intuitive, and empirical considerations, including both the distribution of responses in the Alameda County dataset and the mortality rates observed at different levels of the component variables. The resulting index is mathematically complex. In order to understand the structure and the sensitivity of the BSNI to its components, we analyzed its algebraic structure.

Construction of the BSNI may be outlined as three steps:

(1) The items concerning availability of close relatives, availability of close friends, and frequency of visits are combined into a "Sociability Score", categorized into Low, Medium, High;

(2) Marital Status and Sociability Score are combined into an "Index of Intimate Contracts", again categorized as Low, Medium, High.

(3) The Index of Intimate Contacts is combined with the values of variables indicating membership in a church group and membership in some other group or organization, with weights of 4:2:1 for intimate contacts:church group:other group. Thus, with suitable coding of each variable, the BSNI can be rendered by the formula:

BSNI = 4(Index of Intimate Contacts)

+ 2(church group membership)

+ (other group membership)

- 3

where the Index of Intimate Contacts ranges from 1 (low) to 3 (high) and the two membership variables take values of 0 (not member) or 1 (member).

The 12-value index is then categorized as I. Low (1), II. Medium (2-5), III. Medium-high (6,7) and IV. High (8-12).

In the grouped index, Category I (low) results from a low intimate contacts index and no membership in church or other groups. The other categories can each result from multiple combinations of intimate contacts and group memberships. To be classified in category IV (high), a subject must have either high Intimate Contacts (regardless of memberships) or medium Intimate Contacts together with both church and group membership.

Beyond these relationships, visualization of the sensitivity of the BSNI category or score to the values of its components is hampered by the absence of a simple algebraic formulation for the Index of Intimate Contacts. The Index of Intimate Contacts combines marital status and the Sociability Score. For most combinations, the value of the Index of Intimate Contacts can be expressed by the following formula:

Index of Intimate Contacts =

Marital Status + Sociability Score – 1

where:

Marital Status is dichotomous (1= married, 0= not married), and

Sociability Score has values of low (1), medium (2), or high (3).

An exception occurs when both components are at their lowest levels; in this case the Index of Intimate Contacts is 1, rather than zero.

The Sociability Score, in turn, derives from an availability measure (two items) and a frequency measure (one item). The availability measure is, in effect, an "ordinal average" of the responses to the items on number of close friends and number of close relatives. Since the response choices for these two items called for ranges, the averaging operation is most easily perceived by examining the midpoint values of the response choices (e.g., 3-5 friends is translated to 4, 5-9 friends is 7, etc.) The resulting availability measure has four values, corresponding to midpoint ranges of 0-4, 5.5-9, "10+"-11.5, and "14+" up. The "10+" and "14+" reflect the unavailability of midpoint values for the highest response range, "10+".

The frequency measure consists of the single item about the number of friends and relatives seen at least once a month, with responses again representing ranges. The frequency and availability dimensions are combined as follows:

1. For the lowest availability value (1), the Sociability Score is 1 (low), regardless of frequency.

2. For the highest availability value (4) together with a frequency value of at least 6 visits per month, the Sociability Score, after collapsing of categories, is 3 (high);

3. All other combinations of availability and frequency yield intermediate values, which after collapsing of categories produces a Sociability Score of 2 (medium).

The BSNI as a whole, therefore can be rendered by the following algebraic expressions:

BSNI = 4I + 2C + G – 3

= 4(M + S) + 2C + G – 3 [this appears to be in error]

= 4M + 4S + 2C + G - 7 (when M + S > 1)

OR

= 2C + G + 1 (when M + S = 1)

where:

I (the Intimate Contacts Index) =

M + S - 1 if M + S > 1 or M + S if not;

M (marital status) = 1 if married or 0 if not;

S (Sociability Score) = 1 (low), 2 (medium), or 3 (high);

C (church group membership) = 1 if a member and 0 if not;

G (other group membership) = 1 if a member and 0 if not.

The contribution of church group membership is, therefore, twice that of other group membership and in most cases half that of marriage.

Frequency of visits from friends and relatives can have the same quantitative impact as marriage, but only when the subject reports having 13 friends and relatives. Only the maximum value of sociability (at least 13 friends and relatives and at last 6 visits per month) can substitute for marriage; in the presence of marriage, though, increasing the sociability score from its minimum value to its maximum, raises the BSNI value by a full 8 points, the largest possible impact from changing a single variable value. Marriage is essential to reach BSNI category IV (high) unless the subject has 13 or more close friends and relatives, sees at least 6 of them monthly or more often, and belongs to both a church and other type of group. A subject in BSNI category I (low) can be married and can have numerous visits from close friends and relatives if the total number of such close friends and relatives is five or fewer.

IV. CONSTRUCTION OF THE EVANS COUNTY SOCIAL NETWORK INDEX

Construction of the Evans County Social Network Index required three tasks:

1. identification of items comparable to those in the Alameda questionnaire;
2. identification of cut-points for each item, comparable to those used by Berkman and Syme;
3. combination of items in a manner similar to that employed by Berkman and Syme;

One aim that guided the construction was to achieve an index with a population distribution that was similar to that of the BSNI.

(1) Selection of Variables from the Evans County Sociological Questionnaire

Variables from the 1967 Evans County Sociological Questionnaire that corresponded to items in the Berkman Social network index were evaluated for their conceptual content. We also took account of the variable distributions in the 2170 persons who took the sociological questionnaire.

We chose from among the following items for the social network variable:

1. Marital status. Marital status was a seven-level variable, which we dichotomized in the same manner as Berkman: married (75.5%) versus not married (24.5%).
2. Friends and relatives. The Evans County questionnaire contained five items denoting contact with friends and relatives:
3. About how many families who are *relatives* (kinfolk) of yours live in or around Evans County.
4. IF "ONE" OR MORE, ASK: About how many of these families (relatives) do you see fairly often (about 5-6 times a year)?
5. About how many neighbors around here do you know well enough to visit with?
6. Altogether about how many people are there whom you consider to be *close* friends-- *not counting relatives or neighbors*? (IF NECESSARY, ADD:) "Just give a rough estimate." (DEFINITION OF "CLOSE FRIEND": A person to whom you can tell what's on your mind.)
7. In times of personal troubles, about how many people do you think you can *depend on* for help?

Response options for each item were:

[None, one, 2-3, 4-5, 6-9, 10-14, 15+, Other (specify)]

(The 4th item included a "Don't know" choice.]

We selected items 1 and 4. We excluded item 2 because responses to item 1 and item 2 were nearly identical. We considered item 3 for inclusion, despite its absence from the Alameda questionnaire, because the Evans County item about close friends (item 4) excluded neighbors. Nevertheless we did not include item 3 in the final index for two reasons: (1) comparison of the sociability scores that included relatives, friends, and neighbors with the sociability score consisting of only relatives and friends showed that the distribution of the latter sociability score better approximated the distribution of the Berkman Sociability Score; (2) the correlation between the sociability scores with and without the neighbors variable was high (r=.93).

C. Church group membership. Though the Evans County Sociological Questionnaire contained no specific items on membership in church or other groups, the questionnaire did contain several related items:

1. Quite aside from church going, how important in general would you say religion is to *you*: *very* *important*, *somewhat important*, *not important at all*?

2. Are you a church-goer? (Yes, No, No Response)

IF "YES," ASK: How often do you generally attend?

 % of respondents

 Daily 1

 2 or more times weekly 13

 Once weekly 26

 A few times monthly 32

 Once a month 13

 A few times a year 10

 Once a year 0

 Less than once yearly 0

 Never 4

 (No response) 1

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 100

There was also an item "What are the *main* things you *usually* do in your spare time?" which included "church activities --prayer meeting, church, etc." as one of sixteen choices. Responses to this choice were evenly divided between yes and no (including missing, assumed no).

We used the spare time activity item to measure church group membership because: (1) the spare time item seemed closer to the church group membership item in the Alameda questionnaire item; (2) the Alameda county questionnaire contained an item on church attendance, but Dr. Berkman had not included it in her index. We did, however, construct an alternate index based on church attendance to examine in exploratory mode. For this alternate index, we categorized church attendance as: weekly or more often (40%), twice a month (32%), and once a month or less often (23%).

50.7 percent of the Evans County subjects reported doing church activities in spare time; 40.2 percent indicated that they did not. 9.1 percent of subjects did not respond to the church activities choice and were treated as nonparticipants in church activities. By comparison, 31.7 percent of the Alameda County sample reported belonging to a church group.

D. Group membership. Since none of the Evans County items were similar to the Alameda items, we had to omit this component of the index.

V. CONSTRUCTION OF THE EVANS COUNTY SOCIAL NETWORK VARIABLE

The Evans County social network index was constructed in three steps: (1) forming a sociability score from friends and relatives items; (2) forming an intimate contacts index from marital status and the sociability score; and (3) forming a social network index from the index of intimate contacts and church membership. The details of the procedures follow:

1. *Sociability Score*:

The Sociability score was obtained from the sum of midpoint values for responses to the relatives and friends variables. This sum ranged from 0 to 35. We used cutpoints of 5 and 17 to designate Low, Medium, and High sociability. (The cutpoints used by Berkman and Syme were midpoint sum values of 4 and 15.) The score distributions on both the Berkman Sociability Score and the Evans County Sociability score were:

Social network index categories

 Score Alameda Evans County

 Low 17 16

 Medium 64 56

 High 19 28

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 Total 100 100

“Blind comment” in the original MASS-11 document had some numbers from Table 2 in Berkman and Syme article.

(2) Index of Intimate Contacts

The Index of Intimate Contacts score (labelled "Low", "Medium", "High") combined Sociability Score and Marital Status in the same manner as did Berkman and Syme. The distributions of the Index of Intimate Contacts in the two populations were:

Social network index categories

 Value Alameda Evans County

 Low 27 29

 Medium 55 48

 High 18 23

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 Total 100 100

(based on 2073 persons in Evans County with Intimate Contact scores).

(3) Social network variable

The procedure for calculating Social Network scores from the Intimate Contacts and Church Attendance values was identical to that employed for the BSNI with the omission of a group membership component. The formula was:

Social Network Score =

 4 x (Index of Intimate Contacts - 1)

+ 2 x (Church activities - 1) + 1

The social network variable scores ranged from 1 to 11, with 6 as a median and 7 as a mode (19.3 percent of the 2053 persons with available social network values fell into this category). We then collapsed the 11 values of the resulting social network index into four major categories, similar to those of Berkman. The categories and frequency distributions for the Alameda and Evans County social network variables are:

Social network index categories

 Alameda County Evans County

 Category Value Percent Value Percent

 Low 1 9.2 1 13.6

 Medium 2-5 31.0 2-5 39.2

 Medium-high 6-7 27.6 6-7 23.1

 High 8-12 32.0 9-11 24.1

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 Total 99.8 100.0

Source: Evans County distribution in folder "Construction of the social network indexes", run SNICORR, 5/2/1983.

Notes:

1.  The distribution of the social network index in which church attendance was used instead of spare time in church activities was: Low (8.8%), Medium (33.6%), Medium-high (34.6%), High (23.0%).

2. Dichotomizing the church attendance variable led to a social network variable with a distribution skewed toward low scorers: the mode was 4 and the two lowest social network values contained one-third of the sample.

3. Categorizing church attendance so that the middle value contained both monthly attenders and twice-monthly attenders resulted in a social network variable that was also unacceptable. Some social network values had very low frequencies (only 4.8% of the sample fell into the low category), while others had disproportionately high frequencies (over 40 percent of the sample were counted as medium-high). Moreover, these distributions were very different from those of the Berkman sample.

4. Revising the church attendance variable so that the middle value included only persons who attended church twice a month or more resulted in both a more evenly distributed church attendance variable, and a more normally distributed social network variable.