THE CONTRIBUTION OF THE SOCIAL ENVIRONMENT TO HOST RESISTANCE[1]

THE FOURTH WADE HAMPTON FROST LECTURE

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I count myself honored indeed to be included among those who have been chosen to present this, the Wade Hampton Frost Lecture. Unlike my predecessors in this series, I never had the privilege of knowing or meeting Dr. Frost, although of course I know many of his illustrious students. I do claim one unique experience, however; I read his collected papers when practicing in South Africa before I had ever heard of the word epidemiology, much less knew what it meant. In a real sense, then, those papers were my introduction to the whole field, and for this I must thank my very wise chief, Dr. Sidney L. Kark, who introduced me to the papers, particularly the section on tuberculosis. The thinking displayed in those articles opened my eyes to a new world and provided an opportunity to begin to understand what up until then had been to me a totally mysterious phenomenon, the explosive epidemic of tuberculosis I was witnessing in the African population for whom I was providing care.

Perhaps, though, of all the words Frost wrote, the ones that have made the most impression on me have been his often quoted introduction to the reprinting of John Snow's papers (1) which starts, "Epidemiology at any given time is something more than the total of its established facts. It includes their orderly arrangement into chains of inference which extend beyond the bounds of direct observation." It is this "orderly arrangement into chains of inference" which intrigues me and which I think distinguishes creative epidemiologic studies from studies which may display considerable rigor in their methods but which are essentially pedestrian.

The question then is, what guides us in developing these chains of inference? Unquestionably, in large part the answer is the model of disease causation which we (implicitly or explicitly) espouse. In Frost's day this model, stated in its most general form, was that disease occurred as a result of new exposure to a pathogenic agent. It was recognized, of course, that the consequences of such exposure would be determined both by the pathogenicity of the agent and the degree of resistance or susceptibility of the host. This relationship has now been extended and formalized into the well-known triad of host, agent and environment in epidemiologic thinking. Since Frost, the elucidation of host resistance factors has largely been the responsibility of the vastly expanded fields of biomedical research, such as genetics, molecular biology, immunology, biochemistry and endocrinology; while epidemiology has continued to search for the effects of a vastly expanded array of pathogenic agents in the environment. The inferences drawn on the basis of such findings have been that, given a certain level of resistance (for whatever reasons), we should be able to explain the occurrence of disease as a result of exposure to these pathogenic agents.

René Dubos (2) has recently pointed out, however, that this formulation, which may have provided a satisfactory basis for inferences in the 19th and early part of the 20th century when most diseases of interest (such as typhoid, cholera, smallpox or plague) were the result of agents of over-

whelming pathogenicity and virulence, is no longer of particular use in a technologically developed society. In a modern society the majority of the citizens are protected from these overwhelming agents and most of the agents associated with current diseases are ubiquitous in our environment. Dubos states it quite succinctly: "The sciences concerned with microbial diseases have developed almost exclusively from the study of acute or semi-acute infections caused by virulent microorganisms acquired through exposure to an exogenous source of infection. In contrast, the microbial diseases most common in our communities today arise from the activities of microorganisms that are ubiquitous in the environment, persist in the body without causing obvious harm under ordinary circumstances, and exert pathological effects only when the infected person is under conditions of physiological stress. In such a type of microbial disease, the event of infection is of less importance than the hidden manifestations of the smoldering infectious process and than the physiological disturbances that convert latent infection into overt symptoms and pathology" (2).

Thus Dubos is stating that in societies where most disease agents are ubiquitous in the environment (and I believe his statement would cover most physiochemical agents, not only microbiologic ones), a full understanding of the distribution and determinants of disease requires that we know both the prevalence and toxicity of these agents *and* the determinants of those factors which change the relationship between the host and these agents, thus transforming an innocuous, possibly symbiotic, relationship to one in which clinical disease is the outcome.

The question facing epidemiologic inquiry then is, are there categories or classes of environmental factors that are capable of changing human resistance in important ways and of making subsets of people more or less susceptible to these ubiquitous

agents in our environment? When we have thought of these questions at all, we have been accustomed to think in rather general terms of such things as nutritional status, fatigue, overwork or the like. I would suggest, however, that there is another category of environmental factors capable of producing profound effects on host susceptibility to environmental disease agents, and that is the presence of other members of the same species, or more generally, certain aspects of the social environment.

The problem is that as soon as one introduces the concept of the potential role of the social environment in disease etiology, the almost inevitable response is that this means stress and stress disease. I think the simple-minded invocation of the word stress in such thinking has done as much to retard research in this area as did the concepts of the miasmas at the time of the discovery of microorganisms. While there can be no question regarding the use of the concept of stress in the hands of the originators of this term (as applied in a scientific sense to medicine), and that Selye and Wolff (3), for instance, have made a significant contribution to our ideas about the nature of disease and its causes, the current uncritical subscription to what are thought to have been the ideas of these investigators and the often erroneous interpretation of their theories by modern investigators has frequently led to contradictory findings and inappropriate inferences.

First it is important to recognize the semantic difficulties surrounding the use of the word "stress." By Selye and Wolff stress was envisaged as a bodily state, not a component of the environment. Thus Wolff (3) states, "I have used the word stress in biology to indicate that state within a living creature which results from the interaction of the organism with noxious stimuli or circumstances, i.e., it is a dynamic state within the organism; it is not a stimulus assault, load symbol, burden, or any aspect of environment, internal, external, social or otherwise." While Wolff dem-

onstrated that this stress state (evidenced by neuroendocrinal changes) can be produced by a variety of noxious stimuli, physical as well as psychologic, he did not attempt to define the characteristics or the properties of these nonphysical (psychologic and/or social) noxious stimuli. Despite such formulations, subsequent investigators have tended to apply the term "stress" to these postulated noxious social or psychologic stimuli, often quoting Wolff for their justification. The use of the word "stressor" to indicate the environmental noxious stimulus and "stress state" or more frequently "stress disease" to indicate the postulated consequences of such exposure clarifies the semantic difficulty but highlights the more important conceptual issue. Stated in its most general terms, the formulation subscribed to (often implicitly) by most epidemiologists and social scientists working in this field is that the relationship between a stressor and disease outcome will be similar to the relationship between a microorganism and the disease outcome. In other words, the psychosocial process under investigation is envisaged as a stressor capable of having a direct pathogenic effect analogous to that of a physicochemical or microbiologic environmental disease agent. The corollaries of such a formulation are that there will be etiologic specificity (each stressor leading to a specific stress disease), and there will be a dose-response relationship (the greater the stressor, the more likelihood of disease). There is serious doubt as to the utility or appropriateness of both of these notions.

Wolff himself stated quite explicitly that the action of physicochemical disease agents is different from psychosocial factors in that the former have a direct pathogenic effect by damaging and distorting structure and function, while the latter act indirectly (or, as he termed it, conditionally) by virtue of their capacity to act as signals or symbols (3). Thus, disease can occur by virtue of a disturbance in the balance between the organism and various disease agents, as maintained by Dubos (2), and if this balance is mediated largely by the neuroendocrine system, as has been maintained by Cannon (4) and Schoenheimer (5) and widely accepted since, then the mechanism through which the signals and symbols produced by the conditional noxious stimuli work presumably will be by altering neuroendocrine secretions and levels in the body and thus changing the balance. As will be referred to later, there is evidence from both animal and human experiments indicating that variations in the social milieu are indeed associated with profound endocrine changes in the exposed subjects.

Viewed in this light, it is most unlikely that any given psychosocial process or stressor will be etiologically specific for any given disease, at least as currently classified. In other words, it no longer becomes useful to consider a subset of existing clinical entities as "stress" diseases as all diseases can in part be due to these processes. Hinkle (6), arguing from the biologic evidence, supports this point strongly when he states: "At the present time the 'stress' explanation is no longer necessary. It is evident that any disease process, and in fact any process within the living organism, might be influenced by the reaction of the individual to his social environment or to other people."

A more reasonable formulation would hold that psychosocial processes acting as "conditional" stressors will, by altering the endocrine balance in the body, increase the susceptibility of the organism to direct noxious stimuli, i.e., disease agents. The psychosocial processes thus can be envisaged as enhancing susceptibility to disease. The clinical manifestations of this enhanced susceptibility will not be a function of the particular psychosocial stressor, but of the physicochemical or microbiologic disease agents harbored by the organism or to which the organism is exposed. Presumably, the disease manifestations will also be determined by constitutional

factors, which in turn are a function of genetic endowment and previous experience.

Some reasonably convincing data exist to support this point of view. For example, one of the striking features of animal studies concerned with demonstrating the health consequences of a changed social environment has been the wide range of diseases that have followed such changes. Alteration of the social environment by varying the size of the group in which animals interact, while keeping all aspects of the physical environment and diet constant, has been reported to lead to a rise in maternal and infant mortality rates; an increase in the incidence of arteriosclerosis; a marked reduction in the resistance to a wide variety of direct noxious stimuli, including drugs, microorganisms and x-rays; an increased susceptibility to various types of neoplasia; alloxan-produced diabetes; and convulsions (7-15). Thus, in animals at least, no specific type of "stress disease" appears in response to changes in the social milieu—changes which have been interpreted as "stressors." Rather, the animals appear to respond with a variety of diseases, the particular manifestation being determined by factors other than the disturbed social process. The evidence from human studies is somewhat less direct but nevertheless still consistent with this idea. A remarkably similar set of social circumstances characterizes people who develop tuberculosis (16) and schizophrenia (17, 18), become alcoholics (19), are victims of multiple accidents (20), or commit suicide (21). Common to all these people is a marginal status in society. They are individuals who for a variety of reasons (e.g., ethnic minorities rejected by the dominant majority in their neighborhood; high sustained rates of residential and occupational mobility; broken homes or isolated living circumstances) have been deprived of meaningful social contact. It is perhaps surprising that this wide variety of disease outcomes associated with similar circumstances has generally escaped comment. To a large extent this has probably resulted from each investigator usually being concerned with only one clinical entity so the features common to multiple disease manifestations have tended to be overlooked.

One exception to this has been the study by Christenson and Hinkle (22). In an industrial study in the United States, they have shown that managers in a company who, by virtue of their family background and educational experience were least well prepared for the demands and expectations of industrial life, were at greater risk of disease than age-matched managers who were better prepared. They found that this increased risk included all diseases, major as well as minor, physical as well as mental, long-term as well as short-term. A further example illustrating this point is the health consequences that follow the disruption of important social relationships, particularly death of a spouse. It has been shown that widowers have a death rate three to five times higher than married men of the same age for every cause of death (23). It is difficult to conceive of a specific etiologic process responsible for the increased death rate from such diverse conditions as coronary heart disease, cancer, infectious diseases and peptic ulcer, and it would appear more reasonable to consider that the loss of the spouse increases the susceptibility of such men to other disease agents.

Of course this position that psychosocial factors act as conditional or predisposing factors rather than as direct pathogenic agents is no different from the position taken by the psychosomasists, who have maintained quite specifically that psychologic factors should be regarded as predisposing rather than direct etiologic agents in disease. Where it does differ is suggesting that these order of factors will not be etiologically specific for any given disease (at least given the current clinical classification of diseases) and that research aimed

at searching for a specific subset of "stress diseases" or attempting to link one type of stressor to a single clinical manifestation is likely to be unproductive.

My position on this complete absence of etiologic specificity (or putting it in another way, that the function of these psychosocial processes is to enhance susceptibility to all disease in general) may have to be modified somewhat by relatively recent developments. Henry (24) has shown that, in animal colonies, animals in the process of establishing their dominance show a sympathetic adrenal medullary catecholamine response and persistent elevated blood pressures. The ones forced into subordination, however, show more of the pituitary adrenal cortical response pattern, a pattern he feels is more consistent with depression and all the disease manifestations that have been associated with depression and hopelessness. If this is true it might be necessary to modify my stance and admit there may be several clusters of diseases associated with different psychosocial situations.

Clarification of the outcomes to be expected from exposure to these psychosocial processes is, however, only one of the dilemmas facing research in this area. It provides no guide as to what these processes might be, much less how they are to be measured.

One of the unfortunate controversies that has clouded research in this area has been the one about whether such stressors are invariant, affecting all people in a similar manner, or whether they are idiosyncratic, affecting each person differently depending upon his personality, interpretation of the situation, and so forth. The position for the latter point of view (which might be summarized as "what is one man's meat is another's poison") has recently been stated quite succinctly by Hinkle (6): "In view of the fact that people react to their 'life situations' or social conditions in terms of the meaning of these situations to them, it is difficult to accept the hypothesis that certain kinds of situations or relationships are inherently stressful and certain others are not." Others, including perhaps the majority of investigators, have treated these factors not only as if they were invariant but as if they were unidimensional, the presence of the factor being stressful, its absence beneficial.

Quite clearly, if the idiosyncratic point of view is correct, much of the work to identify universal or general stressors will be futile and lead to contradictory and confusing results. But equally clearly, the contrary point of view ignores the proposition that these processes do not have a direct pathogenic action but operate in their capacity as signals or symbols triggering off responses in terms of the information they are perceived to contain. And as this perception will almost certainly be a function of the differing personalities and the salience of the experience to different individuals, it is hard to accept the notion that certain social circumstances will always, or even in the majority of cases, be "stressful." This dilemma can best be resolved, I believe, by two changes in our thinking, changes which appear consistent with most of the data and which conceivably explain some of the existing contradictions. The first of these is that the extent to which the postulated psychosocial processes are generally noxious versus idiosyncratic in their action is largely a function of our level of abstraction. If we can identify the characteristics or properties of those signals or symbols which generally evoke major neuroendocrinal changes in the recipients, we will have identified a general class of stressors even if the particular circumstances or relationships creating those types of signals or symbols differ for different people. Furthermore, if we can identify the attributes of this class of stressors, it may well be that the same relationships or social circumstances within a given culture (or, perhaps, subculture) regularly produce such a class of signals. Secondly, the existing data have led me to believe that we should no longer treat psychosocial processes as unidimen-

sional stressors or non-stressors, but rather as two-dimensional, one category being stressors, and another being protective or beneficial.

The evidence supporting these points of view comes from both animal and human research. As has been indicated earlier, altering the social milieu of animals by increasing the number housed together leads to marked changes in health status, even when all relevant aspects of the physical environment and diet are kept constant. The biologic mechanisms through which such changes are produced have also been identified. Changes in group membership and the quality of group relationships in animals have been shown to be accompanied by significant neuroendocrinal changes affecting the pituitary, the adrenocortical system, the thyroid and gonads (25, 26). These same endocrines are those responsible in large part for maintaining what Schoenheimer (5) has termed "the dynamic steady state" of the organism, and thus, presumably, its ability to withstand changes which would result from the action of disease agents.

The questions of concern are, what are the properties of the changes in this social milieu, and are there analogues in the human social system? The usual notion that the crowding itself (that is, the physical density of the population) is responsible for the deterioration in health status has not been sustained in human studies. Despite the popularity of the belief that crowding is harmful to health, a review of the literature shows that for every study indicating a relationship between crowding and some manifestation of poor health, there is another equally good (or bad) investigation showing either no relationship or even an inverse one (27, 28). Furthermore, Hong Kong, one of the most crowded cities in the world, and Holland, one of the most crowded countries, enjoy some of the highest levels of both physical and mental health in the world (29).

A careful review of the data reported from these animal studies may hold a clue to these puzzles. In animals, an almost inevitable consequence of crowding is the development of a set of disordered relationships among the animals. These, while manifested by a wide variety of bizarre and unusual behaviors, often have in common a failure to elicit anticipated responses to what were previously appropriate cues. Thus, habitual acts of aggression (including "ritualized aggression" in defending the nest), or evidence of acceptance of subordination on the part of one animal, fail to elicit appropriate reciprocal responses on the part of another. In social animals under wild conditions, for example, the occupier of a nest will define a zone around that nest as "home territory." Invasion of this territory by another animal of the same species will lead to a set of highly ritualized aggressive moves and countermoves, rarely leading to bloodshed, but culminating in one or the other animal "signaling" capitulation. Under crowded conditions the defending animal may initiate this ritual "dance," but the invading animal fails to respond in the anticipated fashion. Instead he may lie down, go to sleep, attempt to copulate, walk away, or do something which, for the situation, is equally bizarre.

This failure of various forms of behavior to elicit predictable responses leads to one of three types of responses on the part of the animals involved, the most common of which is repetition of the behavioral acts. Such acts are always accompanied by profound neuroendocrinal changes, and presumably their chronic repetition leads eventually to the permanent alterations in the level of the hormones and to the degree of autonomic nervous system arousal reported under conditions of animal crowding. The fact that these behavioral acts are in a sense inappropriate, in that they do not modify the situation, can be expected to enhance such hormonal changes. Under

these conditions it is not difficult to envisage the reasons for the increased susceptibility to environmental insults displayed by such animals.

An alternative response on the part of some animals is to withdraw from the field and to remain motionless and isolated for long hours on end. It is not uncommon to observe some mice under crowded conditions crouched in most unusual places, on top of the razor-thin edge of a partition or in the bright light in the center of the enclosure, completely immobile and not interacting with any other animals. Such animals do not exhibit the increased pathology demonstrated by the interacting members (7).

The third alternative is for animals to form their own deviant groups that apparently ignore the mores and codes of behavior of the larger group. Thus, "gangs" of young male rats have been observed invading nests, attacking females (the equivalent of gang rapes has been reported), and indulging in homosexual activities. I am not aware of any data on the health status of these gang members, but according to this hypothesis they also should not exhibit any increase in pathology.

These observations would suggest that at least one of the properties of stressful social situations might be that the actor is not receiving adequate evidence (feedback) that his actions are leading to anticipated consequences. While we do not as yet have the appropriate instruments to measure in any direct fashion the extent to which such a phenomenon is occurring in humans, it is not unreasonable to infer that this phenomenon is highly likely to occur under certain circumstances. First, it is probable that when individuals are unfamiliar with the cues and expectations of the society in which they live (as in the case of immigrants to a new situation, or of individuals involved in a rapid change of social environment, such as the elderly in an ethnic enclave caught up in urban renewal), many

of their actions and the responses to these actions would fall into this category and thus, if this suggestion is correct, they should be more susceptible to disease than those for whom the situation is familiar. Another circumstance in which this lack of feedback might occur would be under conditions of social disorganization. This, while still being far from a precise term which can be measured accurately, has proved to be a useful concept in a number of studies.

As indicated earlier, however, a fuller explanation of the potential role of psychosocial factors in the genesis of disease requires the recognition of a second set of processes. These might be envisioned as the protective factors buffering or cushioning the individual from the physiologic or psychologic consequences of exposure to the stressor situation. It is suggested that the property common to these processes is the strength of the social supports provided by the primary groups of most importance to the individual. Again, both animal and human studies have provided evidence supporting this point of view. Conger et al. (30), for example, have shown that the efficacy with which an unanticipated series of electric shocks (given to animals previously conditioned to avoid them) can produce peptic ulcers is determined to a large extent by whether the animals are shocked in isolation (high ulcer rates) or in the presence of litter mates (low ulcer rates). Henry (31) has been able to produce persistent hypertension in mice by placing the animals in intercommunicating boxes all linked to a common feeding place, thus developing a state of territorial conflict. Hypertension only occurred, however, when the mice were "strangers." Populating the system with litter mates did not produce these effects. Liddell (32) found that a young goat isolated in an experimental chamber and subjected to a monotonous conditioning stimulus will develop traumatic signs of experimental neurosis while

its twin in an adjoining chamber and sub-jected to the same stimulus, but with the mother present, will not.

The evidence from human epidemiologic studies is somewhat more circumstantial, yet I believe not inconsistent with these notions, and it certainly suggests that it is worthwhile to pursue these areas of investigation.

I have selected a number of studies which illustrate the potential importance of these twin themes, lack of appropriate feedback to individuals and absence of social supports. On some occasions these have been indexed by situations of rapid social change or social disorganization, on others by attempts to measure the processes more directly. I have deliberately selected examples which employ a variety of research designs and which have examined the phenomena in relation to a wide variety of health outcomes.

The first is an older study of our own designed to illustrate the potential importance of rapid social change (33). It took place in the mountains of Appalachia, where the population had been isolated from developing civilization for about 150 years. In the early 1900's a factory located in one of these mountain coves, and over the next 50-60 years, by deliberate company policy, recruited its labor force from the surrounding mountain coves. By 1960 the factory' was populated by about 3000 workers living in the company town, eating similar diets and doing the same work for the same pay. They were composed of two groups, however. First, there were those who were the first of their family to leave the coves for this new and strange life (where relationships, rights and obligations were no longer determined by kinship, and where personal identity and worth did not depend on the family one came from) and, second, there were those whose fathers had worked in the same factory before them. The company made no distinction between these two groups in terms of work, pay or

promotion, and, in fact, the only way they could be identified was by examining the company records to find out whether a particular worker had had a relative of the same name there before him. The hypothesis of the study was that the second group, by virtue of their previous experience, would be better prepared for the expectations and demands of industrial living than the first group and should thus exhibit fewer signs of ill health. As indicated in figures 1 and 2, when health status was measured by responses to the Cornell Medical Index and sick absenteeism, the prediction held true.

The second study, by Neser et al. (34), is an ecologic study in which the health outcome measured is no longer self-perception of health or health behavior, but death from stroke, and the index of the postulated psychosocial processes, social and family disorganization. For this purpose, all 100 counties of North Carolina were
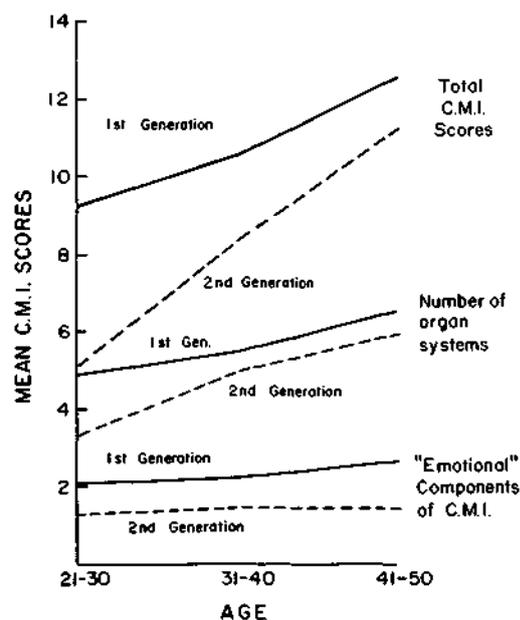

FIGURE 1. Health status measured by responses to Cornell Medical Index (CMI), Appalachian study. Mean scores by age and generation status for those people with 0 or 1 absence during 40 month period. (Figure reproduced by permission from Cassel and Tyroler (33).)
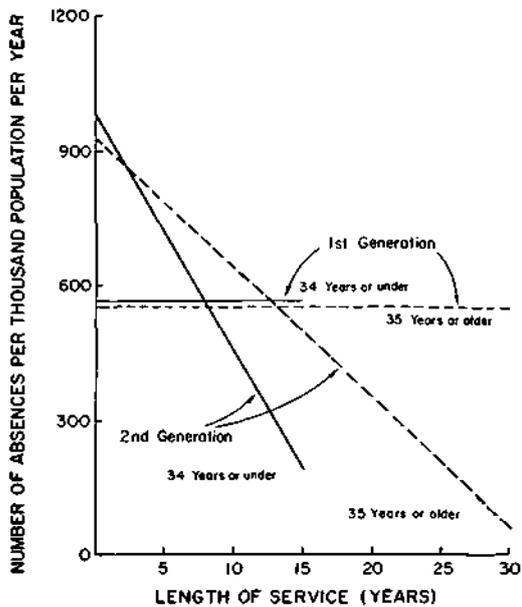
FIGURE 2. Change in number of absences with length of service, by generation status and age groups, Appalachian study, using least squares line of best fit. (Figure reproduced by permission from Cassel and Tyroler (33).)

ranked on the basis of a social disorganization score which had been developed by Dr. Harvey Smith as part of an exercise for the planning of mental health services. The components of the score are: family instability (per cent of primary families with only one parent present); per cent of illegitimate births; rate of males sentenced to prison camps; per cent of population separated or divorced; and per cent of children under 18 not living with both parents.

The ranked counties were then grouped by index severity of the score into five tiers, from the least to the most disorganized, and the stroke mortality rate for Black men for the nine-year period 1956-1964 was computed, basing the population figure on the 1960 census data (figure 3).

As can be seen, there is a marked gradient in stroke mortality with increasing county index of social disorganization, this being most evident in the younger age group. Other than social disorganization, there did not seem to be any particular

features that systematically differed between these various tiers of counties. No tier clustered geographically (making it unlikely that some component of the water or soil was responsible), nor were there any major differences in economic level or access to medical care. To test for the possibility of confounding by an economic factor, however, a subsequent study of James and Kleinbaum (35) expanded the original list of indicators of social disorganization and included a number of economic indicators as well. The resulting county scores were derived by factor analysis which produced two factors, one labeled a social instability factor and the other socioeconomic. The death rates from stroke (limited at this time to 45 to 54-year-old non-white males for 1960) is shown in figure 4.

The difference previously observed persists even when controlling for socioeconomic level, making it unlikely that the findings can be explained on the basis of poverty.

No matter how carefully ecologic studies are done, however, nor how unambiguous their results, the findings are always sus-
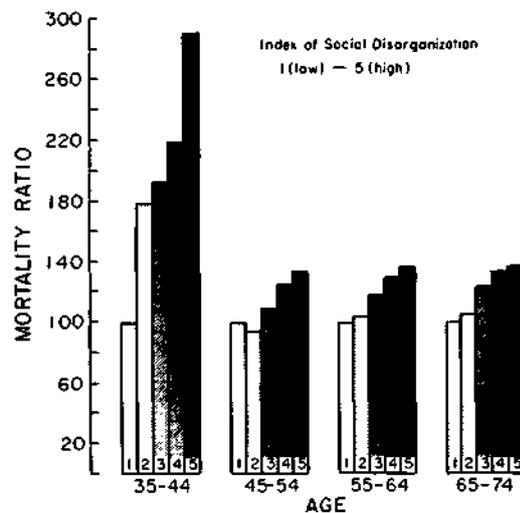

FIGURE 3. Stroke mortality for Black males in North Carolina by county index of social disorganization, 1956-1964. (Figure adapted by permission from Neser et al. (34).)
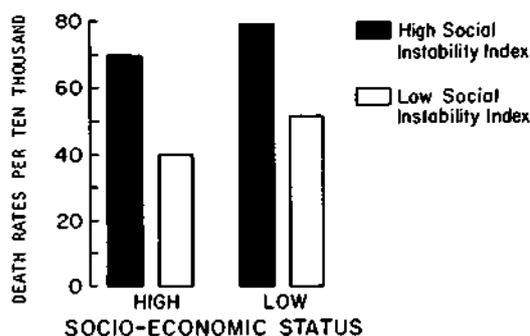
FIGURE 4. Hypertension-related deaths per 10,000 by socioecologic stress levels in non-white males aged 45-54 in North Carolina, 1960. (Figure adapted by permission from James and Kleinbaum (35).)

pect due to the possibility of the ecologic fallacy. It is comforting then to find these results replicated by another study that was conducted in another locality by an independent investigator. This study, conducted in Detroit by Harburg et al. (36), rank ordered all census tracts by various components of what they called stress scores which included residential and family instability, crime and density, and economic deprivation. The scores were also subjected to factor analysis, yielding the two factors of social instability and socioeconomic status. Tracts having both the upper range for the instability score and lower range for the socioeconomic score were labeled high-stress tracts, and the converse for the low-stress tracts. Within each of these tracts a random sample of families was selected (with about an 89 per cent acceptance rate). These family members were interviewed and had their blood pressures measured under standard conditions by trained and standardized interviewers. Figure 5 shows that after controlling for weight, blood pressure levels are higher for Black males at all ages, but particularly at young ages if they live in the high-stress areas.

It is interesting to note that in none of these three studies was the same relationship found for Whites. Two possible speculations can be advanced to explain this apparent anomaly. The first of these re-

lates to the situation of Blacks. In animal experiments, changes in the social milieu have their most marked and dramatic effects on the health and endocrine status of subordinate animals, with dominant ones showing the least effects (37). Perhaps these findings reflect the subservient role that Blacks (until perhaps recently) have been forced to occupy in our society. The second speculation is the possibility that in the face of social disorganization Whites have more resources, including sources of social support to help buffer their physiologic processes from these effects.

The next study uses a further design, case control, and examines a phenomenon first described by a contemporary and colleague of Frost, Jean Downes. In some of her Eastern Health District studies, Downes reported that a small proportion of school children were responsible for a disproportionately large number of school absences, that these tended to be the same children year after year, and that they came from families in which other members had a disproportionately high rate of chronic and emotional illness (38). This study also examined family cohesiveness and the supports available in such families.

Two pools of elementary school children were identified in a sample of 18 Florida schools in a study by Boardman (39). From these pools, 100 families of children who had consistently had the highest absence experience in two successive years were randomly selected and matched by race,
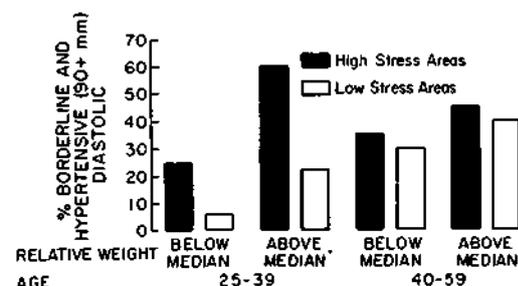

FIGURE 5. Diastolic blood pressure levels by stress areas, age and weight in Black men in Detroit. (Figure reproduced by permission from Harburg et al. (36).)

sex, grade and school attended of the index child with 100 randomly selected families of low-absence children. An instrument to measure the concept of family competence was developed by the investigator and applied blind to each of the 200 families. The components of the family competence score were: commitment of members to family group objectives; communication, or the ability of the group to arrive at a working consensus on issues and problems; pride in family; self-confidence; judgment, or the ability to identify and weigh alternatives; creativity or resourcefulness; and participation, or the commitment of family members to a collective process in the community, their contribution to a definition of goals (39).

In addition, data on a number of possible confounding variables which might account for the high absence rates were also gathered from both groups of families. These variables were: number of family members with time-losing illnesses; presence of father in the home; family size; number of preschool children; mother's age; number of siblings younger than the index child; grade, sex and school attended of the index child; school absence record of the index child; number of chronically ill family members; belief in education; social position; and race (39).

Figure 6 shows the mean competence scores of these two groups of families. In the scores, the non-matched confounding variables have been controlled by stratification in the case of social class and by stepwise partial correlation for the rest. As can be seen from the figure, families of high-absence children consistently had poorer family competence scores (indicating lower cohesiveness and support) than did those of low-absence children. The family members of the high-absence children were also found to have more illness of all sorts than was true in the families of the low-absence children. The study thus confirmed Downes' original findings.
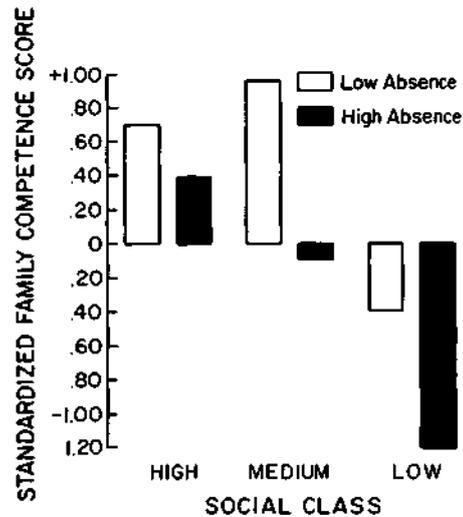
Perhaps one of the more dramatic find-

FIGURE 6. Family competence scores and school absences in children by social class. (Figure reproduced by permission from Boardman (39).)

ings is that of Michael Marmot (40), who was impressed by the findings of the Japanese-Hawaiian-American heart study which showed that the incidence of coronary heart disease was higher in Japanese people living in Hawaii than in those living in Japan and still higher for those living in California than in Hawaii. Furthermore, these differences could not be explained by variations in any or all of the standard risk factors. Marmot wondered what additional factors might explain the high rate of coronary heart disease among the Japanese living in California, and he speculated that in the process of migration they may have lost important sources of social support in the face of bewildering and rapid cultural change.

He conducted a cross-sectional study on a sample of Japanese men living in California and developed an instrument to measure to what extent they had retained the values of traditional Japanese culture. The components of the instrument and the proportions of Japanese men giving "traditional" answers to culture of upbringing questions are shown in table 1. As a validation of this instrument Marmot compared scores obtained for these Californian Japa-

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TABLE 1

Culture of upbringing: proportion of Japanese men living in California giving "traditional" answer on culture of upbringing questions*

Question	"Traditional" answer	% Giving "traditional" answer
Years in Japan	>10 years	30
Age left parents' home	Older than 25	36
Ever lived on a farm	Yes	58
School in Japan	Yes	36
Years in Japanese language school	>5 years	27
Religion (growing up)	Buddhist	55
Friends while growing up	Mostly Japanese	60
Wife's place of birth	Japan	18
Wife schooled in Japan	Yes	19
Wife's school Japanese language	Yes	49

* Table reproduced by permission from Marmot (40).

TABLE 2

Distribution of scores on index, culture of upbringing, by generation, Issei (Japanese immigrants to US) and Nisei (offspring of immigrants)*

Index score		Issei (%)	Nisei (%)
Non-traditional	1	2.0	13.1
	2	5.2	20.5
	3	13.3	25.8
	4	11.6	12.7
Traditional Japanese	5	29.6	18.1
	6	38.4	9.8
Total		100	100

* Table reproduced by permission from Marmot (40).

nese born in Japan with those obtained for those born in the US (table 2).

As can be seen from figures 7 and 8, the prevalence of coronary heart disease (whether measured as angina or as myocardial infarction by history or by electrocardiogram criteria) was always higher in those men who had retained less of their traditional cultural matrix.

To assure that these differences were not simply a function of differences in diet or major risk factors in the two groups, Marmot then controlled for these by stratification, as shown in figures 9-12. In each case (except perhaps for nonsmokers) the same relationship holds true.

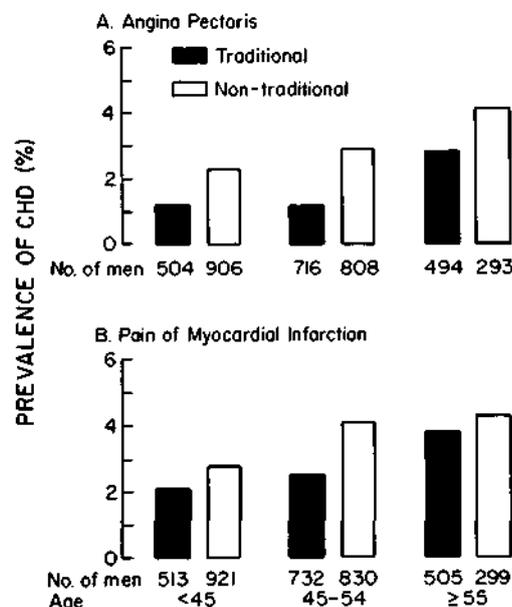One of the few cohort type studies in this

FIGURE 7. Prevalence of coronary heart disease (CHD): angina pectoris and myocardial infarction, measured by cardiovascular questionnaire, by culture of upbringing in Japanese men living in California. (Figure reproduced by permission from Marmot (40).)

field (Nuckolls et al.) was concerned with complications of pregnancy as the outcome (41). Complete data were obtained from 170 white married primiparae of similar age and social class, all delivered by the same service. Social stresses were measured by a cumulative life-change score, a method developed by Holmes and Rahe
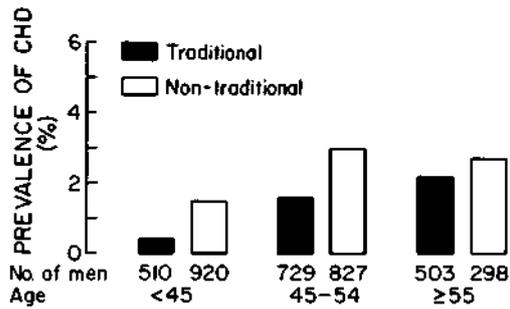
FIGURE 8. Prevalence of coronary heart disease (CHD): major electrocardiogram abnormalities (Minnesota codes 1:1, 1:2, 7:1) by culture of upbringing in Japanese men living in California. (Figure reproduced by permission from Marmot (40).)
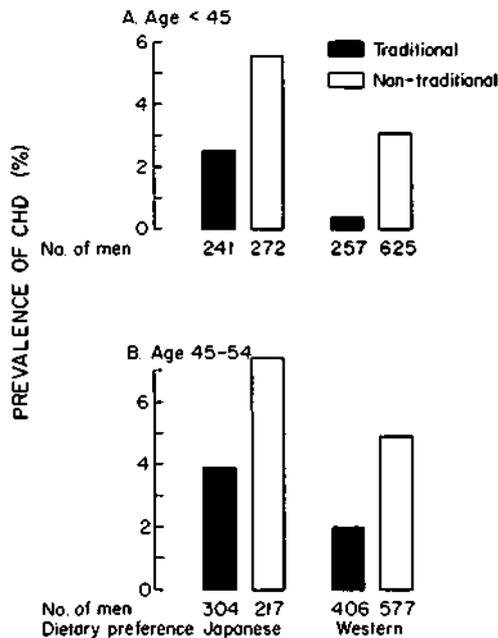

FIGURE 9. Prevalence of definite coronary heart disease (CHD) by culture of upbringing in Japanese men living in California, controlling for dietary preference, Japanese or Western. (Figure reproduced by permission from Marmot (40).)

(42) to assess the major life changes to which an individual had had to adapt. Social supports, or as they were termed, psychosocial assets, were assessed by an instrument developed by the investigator designed to measure the subject's feelings or perceptions of herself (with particular reference to this pregnancy), her relationships with her husband, her extended fam-
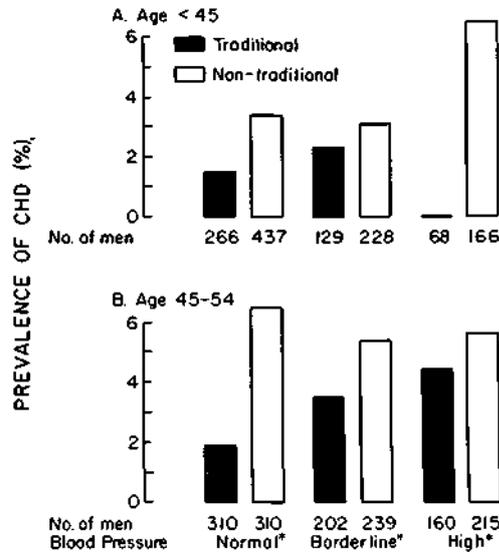

FIGURE 10. Prevalence of definite coronary heart disease (CHD) by culture of upbringing in Japanese men living in California, controlling for blood pressure level. * WHO criteria. (Figure reproduced by permission from Marmot (40).)
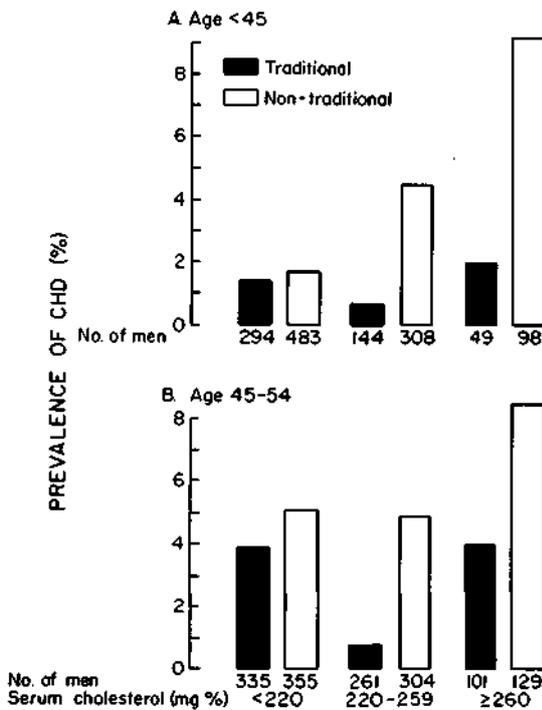

FIGURE 11. Prevalence of definite coronary heart disease (CHD) by culture of upbringing in Japanese men living in California, controlling for serum cholesterol. (Figure reproduced by permission from Marmot (40).)

A. Age <45

PREVALENCE OF CHD (%)

■ Traditional
□ Non-traditional

| No. of men | 113 | 212 | 176 | 345 | 208 | 339 |

B. Age 45-54

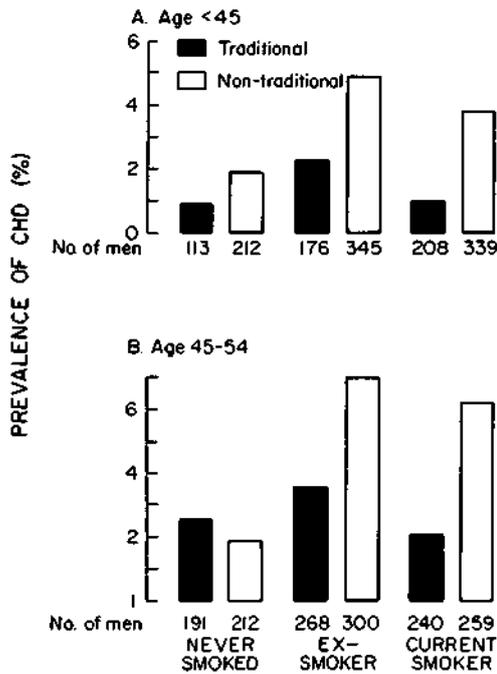| No. of men | 191 | 212 | 268 | 300 | 240 | 259 |
| | NEVER SMOKED | | EX-SMOKER | | CURRENT SMOKER | |

FIGURE 12. Prevalence of definite coronary heart disease (CHD) by culture of upbringing in Japanese men living in California, controlling for smoking habits. (Figure reproduced by permission from Marmot (40).)

ily and her immediate community in terms of the support she was receiving or could anticipate receiving. Both instruments were administered to the subjects before the 32nd week of pregnancy. After delivery, the records were reviewed blind for any evidence of complications of pregnancy or delivery. Among these patients, 47 per cent had one or more minor or major complications, a rate comparable to the 50 per cent found in a national study using the same criteria.

Figure 13 shows that in the presence of high life changes both before and during pregnancy, 90 per cent of women with low assets had one or more complications of pregnancy. With equally high life change scores but with a high support score, only 33 per cent of women had such complications. When life change scores were high prior to pregnancy but low during the pregnancy, the asset score was protective

but less so. Figure 14 shows that when the life change scores prior to pregnancy were low, the asset score was irrelevant.

In an intervention trial, Pless and Satterwhite (43) were concerned with the numerous psychologic handicaps faced by chronically ill children and their family members, handicaps that were seriously interfering with function and appeared to be immune to the interventions of two eminent departments of the medical center, Pediatrics and Psychiatry. As an experiment, they recruited a number of lay persons to serve as sources of social sup-

PERCENT WOMEN WITH ONE OR MORE COMPLICATIONS

■ Social Supports High
□ Social Supports Low

HIGH　　LOW
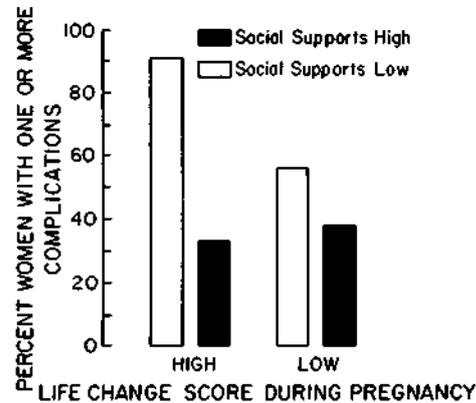LIFE CHANGE SCORE DURING PREGNANCY

FIGURE 13. Complications of pregnancy by life change score and level of social support: high life change score before pregnancy. Study of 170 white married primaparae of similar age and social class, all delivered by the same service. (Figure adapted by permission from Nuckolls et al. (41).)

PERCENT WOMEN WITH ONE OR MORE COMPLICATIONS

■ Social Supports High
□ Social Supports Low

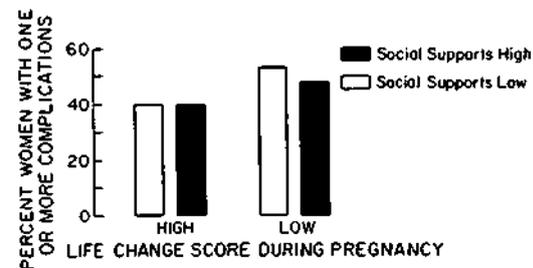HIGH　　LOW
LIFE CHANGE SCORE DURING PREGNANCY

FIGURE 14. Complications of pregnancy by life change score and level of social support: low life change score before pregnancy. Study of 170 white married primaparae of similar age and social class, all delivered by the same service. (Figure adapted by permission from Nuckolls et al. (41).)

port. These family counselors were given little specific training but were carefully screened to insure they had the desirable qualities. Preference was given to a woman who had coped with a chronically ill child of her own and each one was subjected to a battery of psychologic tests to measure such attributes as emotional stability, empathy, dedication, etc.

The families with chronically ill members were then randomized and each counselor was assigned six families in the treatment group, with the other group remaining as controls. Visits to the families were determined by the counselors' availability and the families' needs. The results at the end of one year, based upon a variety of psychologic scores, are shown in figure 15.

Taken alone, then, no one of these studies is entirely convincing. Taken together, however, the results are more impressive. The study designs have varied to include ecologic, cross-sectional, case-control, cohort and randomized controlled trial approaches. The health outcomes have spanned a spectrum from self-reported symptoms and sickness behavior to levels of blood pressure, complications of pregnancy and death. The postulated psychologic stressors and social supports have been assessed by measures ranging from indirect proxy indicators to more direct and focused instruments. In each case a positive finding in the predicted direction
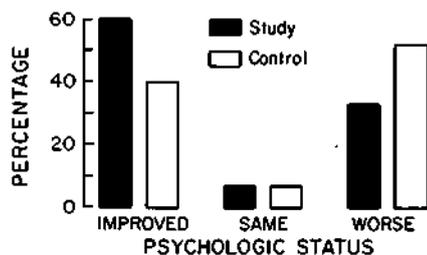

FIGURE 15. Changes in psychologic status of chronically ill children attending medical center pediatric and psychiatric departments after receiving counselling from lay persons recruited to serve as sources of social support. (Figure adapted by permission from Pless and Satterwhite (43).)

has been discovered. Clearly it would have been more desirable if these varied outcomes and/or approaches had been used on the same populations or if different study designs had been used to study the same outcomes. The results, however, appear sufficiently encouraging to warrant further research and to add a further dimension to Frost's "orderly arrangement into chains of inference."

If such research were to support these ideas, it would suggest the need for a radical change in the strategies used for preventive action. Recognizing that throughout all history, disease, with rare exceptions, has not been prevented by finding and treating sick individuals, but by modifying those environmental factors facilitating its occurrence, this formulation would suggest that we should focus efforts more directly on attempts at further identification and subsequent modification of these categories of psychosocial factors rather than on screening and early detection.

Of the two sets of factors, it would seem more immediately feasible to attempt to improve and strengthen the social supports rather than reduce the exposure to the stressors. With advancing knowledge, it is perhaps not too far-reaching to imagine a preventive health service in which professionals are involved largely in the diagnostic aspects—identifying families and groups at high risk by virtue of their lack of fit with their social milieu and determining the particular nature and form of the social supports that can and should be strengthened if such people are to be protected from disease outcomes. The intervention actions then could well be undertaken by nonprofessionals, provided that adequate guidance and specific direction were given. Such an approach would not only be economically feasible, but if the notions expressed in this paper are correct, would do more to prevent a wide variety of diseases than all the efforts currently being made

through multiphasic screening and multi-risk-factor cardiovascular intervention attempts.

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