The Arithmetic of Health/Sickness: A Matter of Pluses and Minuses

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Introduction

I have long been interested in the ingredients which go to make up health/sickness. Fortunately, I was given the opportunity of distilling my thoughts before the Fifteenth Annual Meeting of the American Institute of Dental Medicine in Palm Springs, California in October 1958. That presentation and a subsequent manuscript[1] piqued my interest in the subject and I have pursued it through all of these years. The topic became even more clearly sharpened when I began to put together a series of essays on Medical Ignorance: Myths and Magics in Modern Medicine. At the moment, there are a score or more reports being prepared, in print, or submitted for publication.[28] Here is a review of another of the glaring examples of medical nonsense.

Chalking up the Positives and Negatives

In the final analysis, how well one fares in terms of the quantity and quality of life is the result of a collection of noxious (minuses, subtractions) and benefits (pluses, positives). The outcome derives from the interplay of these two sets of forces. And so, it follows that health/sickness can be expressed in mathematical terms. And the answer(s) become obvious. To the extent possible, eliminate the negative, accentuate the positive, and/or a little bit of both.

The New and Now Ecologic Formula for Health/Sickness

This arithmetic connotation is heightened by all carefully studied natural phenomena and can be expressed in equation form. It is well-documented by the formula for a circle or sphere and just as apparent from the mathematics for renal clearance and cardiac output. And, it should therefore come as no surprise that in this day and age of classical medicine we have a model. Regrettably, it is inadequate and incomplete. Who has not encountered some of the following examples? We insist that Agent A is necessary to solve Medical Problem A (e.g. acne). We have it in our heads that Factor B is the solution to Syndrome B (i.e. baldness). This illogic understandably explains why Preparation H happily helps hemorrhoids! And so, it's not surprising, by extension, that we believe that smoking causes lung cancer. We're dead sure that sooner or later we'll find the virus for arthritis and that baking in the sun makes for skin cancer.

Any way you cut it, we tend to categorize health/sickness in a unifactorial equation. In addition, we suffer with the binomial concept. You're either healthy or ill. You do or you don't have cancer. There is or there isn't diabetes. Common sense, if nothing else, would suggest the fallacies that people are all mad or glad or fat or thin.

The classical diabetic of today (call him 100% diabetic) was the 90% diabetic last year and the 80% the year before. It follows, therefore, there must have been a time when he/she was only 1% diabetic. Hence, there's no question but that part of our problem stems from a lack of recognition of the fact that there's a spectrum from white (pure health) to black (the ultimate in disease).

The Right Side of the Equation

For a number of obvious and not-so-obvious reasons, there has been a shift from infectious problems to chronic syndromes. Assessment methodology has necessarily changed from mortality/morbidity markers to quality of life assessment. And it's interesting how this all came about. For example, in one instance, the design of a questionnaire was entrusted to an eleven-member panel which included patients, spouses of patients, physicians, nurses and a clergyman. A series of interviews were conducted to establish important aspects of daily functioning. By this technique, the Karnofsky Performance Status Index (KPSI) was created.[9] While it was originally designed for use in assessing patients

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with lung cancer, it has been incorporated in a wide range of other settings. The Index is an eleven point scale describing the extent of a patient's independence and his/her ability to carry out normal activity. Each level is given a percentage score (100 = normal, 0 = deceased). Since its publication, the KPSI has become embedded in the literature as perhaps the classic measure, the so-called gold standard.

Hence, we now have available to us two percentage scale systems for expressing the health/disease spectrum. On the one hand, we can cite zero percent nondiabetes to 100% classical or textbook diabetes mellitus. On the other hand, it is possible to quantify degrees of psychosocial independence. And so, we have in a sense, two polar methods for defining the right side of the equation. We can view gradations of the problem in classical disease terms or in shades of disability.

There are still other exciting methods for evaluating the right side of the formula, Nedra Belloc has reported seven levels in the health/ sickness spectrum.[10] The last, the seventh, is the most desired. It is interesting for a number of reasons. First, they are the people who report not only few if any symptoms and signs and high energy reserves. Secondly (by this method), only 5% proved to be superhealthy!

The Left Side of the Equation

First, it should be emphasized that health/ disease is the result of multiple factors. The evidence for this statement is abundant from many different sources including animal studies, medicodental experiences and even the layman's observations. Such experimental support has already been graphically cited.[1]

Whereas there is one element on the right (albeit differently tagged and interpreted), two ingredients are essential on the left. They both have been variously described and defined. For practical purposes, one group may be viewed as those external, and therefore environmental, challenges which invite health/ sickness. The other set of conditions, the internal, is the human organism's capacity to withstand such external bombardments. It is this combination of circumstances that make it possible to explain why three seemingly similar individuals exposed to the same microbial threat eventuate differently: one contracts pneumonia, another the sniffles, and the third is unscathed.

External World

Many environmental challenges have always prevailed such as the extremes of temperature. Other threats like pollution are relatively new. In any case, there are lots of them, some obvious (i.e. tobacco, alcohol) while others are more subtle (i.e. food coloring agents). As but one example, in one restricted disease category, it is claimed that there are 246 known coronary risk factors.[11]

What is most relevant here and now are the new buzzwords such as risk factors and odds ratios. Unfortunately, their definitions and implications have not been clarified. For example, some risk factors are undesirable (negative) in the sense that they should be muted or eliminated to the extent possible. Tobacco consumption is a classical example. Other risk factors are positive (desirable). This is demonstrated by additional vitamin C fortification. The simple fact of the matter is, as has already been pointed out earlier, that we live in a world of pluses and minuses. The trick from a practical therapeutic standpoint is to reduce the minuses as much as possible, or to increase the pluses as effectively as one can. There is the third and most realistic option, namely to reduce the negatives and increase the positives at the same time.

Secondly, implied if not stated is that risk factors have as a common denominator the element of correlation. In some instances, the connection is causative (e.g. alcohol consumption). In other cases, the etiologic connection is not evident. Glaring examples are the role of such risk factors as hand grip and stature in cardiovascular disease. Hence, risk factors become more meaningful when recognized as primary (causally related), secondary or even tertiary (correlative).

Internal Milieu

The fact of the matter is that how well we fare depends upon the world about us (as we have just noted) and our capacity to respond to the challenges of the environment. This latter ingredient is variously referred to by many terms such as resistance/susceptibility, constitution, predisposition, tissue tolerance, coping systems, immunity and/or homeostasis. In the final analysis, the cells singly and collectively as a total organism survive when host

resistance can cope successfully with the innumerable and diverse environmental threats. When the homeostatic machinery collapses host susceptibility replaces host resistance. The same environmental challenges now overwhelm the system and disease and then death ensue.

Much about homeostasis is still unclear; there's continuing research and publication. Some of the activity is academic and complex; fortunately, other aspects are fairly simple and practical. But, the immediate and burning question is,"Where do we get this inner world?" The general concensus today is that most major chronic diseases probably result from the accumulation of environmental factors over time in genetically susceptible persons. This recent citation serves as an excellent reminder of the continuing concern with the contributions of nature versus nurture in illness and in health.[12] Unfortunately, it continues to avoid assigning any relative quantification to the importance of genetics versus the environment.

Quite apart, there is a small (but increasing) body of fact in the scientific literature as well as in humor (e.g. dogs and their owners as well as husbands/wives seem to get to look alike) suggesting that social factors play a more dominant role in the similarities in married couples than heretofore suggested.

Of all of the possible familial combinations, the model which best sorts out genetic versus environmental factors is the husband/wife relationship. Obviously, this is so since there is generally no consanquinity. It is interesting that it is this spouse-likeness issue which has been least discussed of all of the familial permutations.

From these discussions, one must then conclude that it is the pluses and minuses of the external world which influence the internal milieu. It is even these same outside forces that can modify the genetics. This is excitingly borne out at the University of California in Los Angeles.[13] Researchers have linked low levels of vitamin C to increased genetic (deoxyribonucleic acid or DNA) damage in sperm. In plain English, the DNA aberrations in sperm presumably translate into a greater risk of genetic distortions in the fertilized embryo. There results an increased chance of birth defects.

Testing the Ecologic Formula

There are many opportunities to examine health/sickness as it relates to our environment and our capacity to cope with that world. This can be accomplished with very simple and highly measurable variables. Two such examples will be cited.

A Common Stomatologic Experience

Most clinicians and even the man-on-the-street would concede that seemingly similar causative factors may yield widely different clinical results. The invasion by a respiratory germ, as has been cited earlier, may in one instance result in pneumonia. In a second case, there may be only the sniffles; while in the third instance, the patient may remain unscathed.

More appropriate here, calculus (tartar) is regarded as a contributor to periodontal afflictions. Still the same amount of calculus may be associated with less pathologic response in one person than another; and in fact, it may be present with no periodontal pathosis at all in a third. This seeming clinical contradiction, as we have learned earlier, is generally explained in such terms as host resistance and/or susceptibility, immune or coping systems, or tissue tolerance.

Even more appropriate here, clinicians and even the rest of us know well that a seemingly similar problem treated seemingly similarly (even by the same therapist) often nets vastly different results. Thus, for example, scaling (the cleaning and polishing of the teeth) may yield different and sometimes unexplainable results in seemingly similar people.

We know that and it's graphically portrayed (Figure 1) (see p. 250).[14] Shown on the abscissa are the mean gingival inflammation scores for a group of presumably healthy subjects prior to scaling. (As one moves from left to right the gums are poorer.) Depicted on the ordinate are the grades for the same group after cleaning and polishing of the teeth. (As one proceeds upward the gingivae worsens.) It's obvious that most of the subjects demonstrated an improvement in gingival inflammation (shown in the dots representing patients below the diagonal line). A few were unchanged (on the line) and some actually worsened (above). Here's a graphic representation of what has just been described, namely the variability in response to a simple therapeutic

experience.

Let's now back up and tell the whole story.

The scene about to unfold is designed to analyze one common and practical method of evaluating resistance and susceptibility. This will be demonstrated by utilizing blood glucose as a measure of the milieu interieur. The clinical element to be examined is periodontal disease (on the right side of the equation) measure by gingival inflammation.

Forty-five presumably healthy males, ranging in age from 20 to 59 years, were employed for this demonstration. At the first visit, specific gingival areas were graded on a four-point scale ranging from 0 for no gingival inflammation to 3 for classical gingivitis. At this same first visit, venous blood glucose was measured. Finally, one half the mouth randomly chosen was scaled.

Two weeks later, each person was orally reexamined by the same clinician with no knowledge of the earlier scores. Additionally, blood glucose was remeasured.

It's obvious, as we have learned from Figure 1, that different subjects responded differently to the same therapeutic approach. The question is why? Certainly the oral environment was not the same in all the test group (some people had better gums than others initially). Perhaps with other local therapy (e.g. consistently good oral toothbrushing on a daily basis), the gingival response might have been more consistent. Clinical experience says this is likely. But, the general observation also indicates that there may be other, possibly host, factors. What about the role played by the internal world?

Apropos, resistance/susceptibility, mention should be made that there was great variability in blood glucose values. They ranged from a low of 55 to a high of 120 milligrams percent(mg%). If one grants that the generally-agreed-upon physiologic range, the steady state, is 60 to 100 mg%, only three are marginally hyperglycemic; one is hypoglycemic.

Figure 2 graphically portrays the initial blood glucose scores on the horizontal and the final values on the vertical axis. In a sense, this may be viewed as a graphic representation of Bernard's internal world. Utilizing the traditional limits of 60 to 100 mg% for steady state, there are four dots (each representing a person) with an unacceptable internal environment; 41 with a physiologic inner world.

Table 1 shows the means for the two groups before and after scaling. Two points deserve special mention. First, the mean gingivitis score for the subjects with the presumably better resistance in terms of carbohydrate metabolism (60-100 mg%), is lower and better, 0.6 (line 1), than the group with the poorer homeostasis, 0.8 (line 2) prior to scaling. Second, the better resistance group showed a lower gingival score after scaling than those with greater susceptibility, 0.4 (line 1), versus 0.5 (line 2). Thus it seems, within the limits of this study, that the responses to prophylaxis are different and more predictable when judged by carbohydrate metabolism.

In all fairness, we should say there's not general agreement among investigators regarding so-called good and bad blood sugar. Therefore, let's restudy the observations in the light of other more restricted parameters for the milieu interieur.

In Figure 3, the peripheral box describes the initial and final blood glucose levels for a slightly more restricted normal limit (65-95 mg%). Now there are fewer so-called healthy people, 37 (line 3, Table 1), instead of 41, that fall within the physiologic area; eight may be regarded as pathologic. The gingival findings are summarized in Table 1. The mean gingival rating for those with the more satisfactory blood glucose range is less, 0.5 (line 3), than for the relatively more pathologic group 0.8 (line 4). Second, the prescaling gingivitis score at the start is lower (better), 0.5 (line 3), for those with blood glucose levels of 65-95 mg%. Third, the final mean gingivitis score is less in the 65-95 group than in those with blood glucose levels below 65 and above 95 mg%, 0.3 (line 3) versus 0.5 (line 4). In decreasing order, the second and third squares of Figure 3 describe the patterns when one considers an increasingly more steady internal world. The final conclusion is that those subjects with the so-called best blood glucose (75-85 mg%) show, following the cleaning and polishing of the teeth, the best gingival state (closest to 0). The notion that 75-85 mg% seems to be the "ideal" blood sugar has been dealt with in great detail elsewhere.[8]

Here we have the extraordinary opportunity to look at a problem (gingival inflammation) on the right side of the equation in terms of the two factors held to be responsible for such pathosis on the left. This simple experiment,

Figure 1. Comparison of gingival response to scaling in 45 subjects

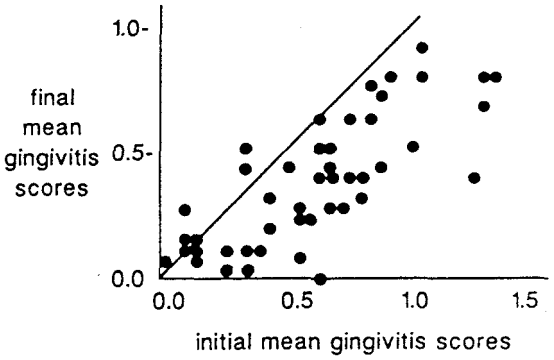
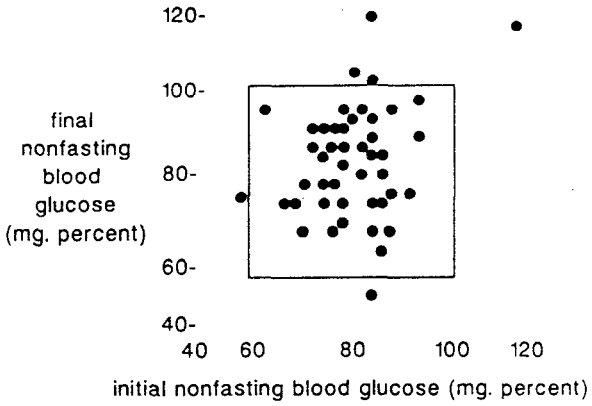


Figure 2. Blood glucose levels before and after therapy viewed by different standards of normality



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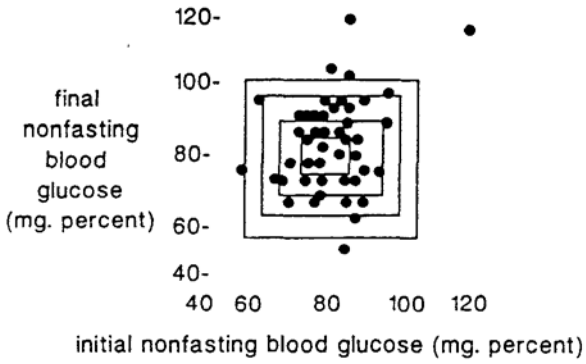

Figure 4. Comparison of gingival response to low refined carbohydrate diet

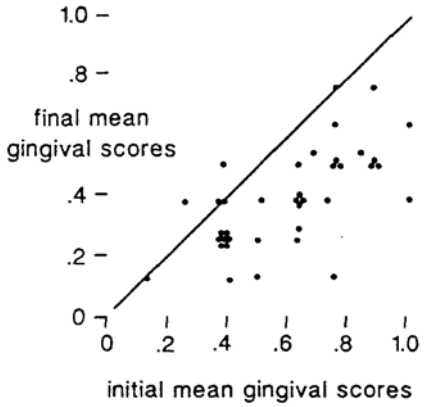

Figure 5. Serum cholesterol level before and after dietary change in terms of different standards of normality

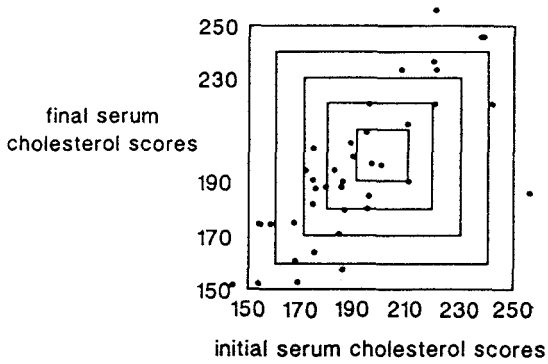

Table 1
Mean Gingivitus Scores Before and After Scaling

Lines	Blood Glucose Ranges	Sample Size	Mean Gingivitis	
			Initial	Final
1	60-100	41	0.6	0.4
2	<60>100	4	0.8	0.5
3	65-95	37	0.5	0.3
4	<65>95	8	0.8	0.5
5	70-90	30	0.5	0.3
6	<70>90	15	0.7	0.5
7	75-85	13	0.5	0.2
8	<75>85	32	0.6	0.4

Table 2
Mean Pre- and Post-Diet Gingival Scores

Lines	Serum Cholesterol Ranges	Sample Size	Initial Mean Gingival Scores	Final Mean Gingival Scores
1	150-250	37	0.58	0.37
2	<150>250	3	0.67	0.47
3	160-240	28	0.57	0.38
4	<160>240	12	0.61	0.38
5	170-230	22	0.57	0.35
6	<170>230	18	0.61	0.42
7	180-220	14	0.56	0.35
8	<180>220	26	0.60	0.39
9	190-210	5	0.46	0.28
10	<190>210	35	0.60	0.39

highly measurable, makes clear in general terms the negative and positive operative forces, namely, the pluses and minuses associated with the air we breathe, the water we drink, and the food we eat.

A Not-So-Common Stomatologic Experience

The emphasis thus far in our one demonstration has been the observation of the oral state (gingival inflammation) in terms of scaling of the teeth in the light of carbohydrate metabolism. Is it possible to use other biochemical measures besides blood glucose (e.g. lipid state) to study the effect on the right side of the equation?

Forty presumably healthy junior dental students shared in this experiment.[15] On Monday of a week, gingival state was graded. The students were then instructed to eliminate, as far as possible, refined carbohydrate foods from the diet. Gingival state was regraded on Friday of the same week by the same examiner with no knowledge of the earlier findings. At both visits, postprandial serum cholesterol was determined.

It's clear (Figure 4) that the mean gingival scores were lower in most of the subjects following the three-day experimental period. Shown on the abscissa are the initial mean gingival grades; on the ordinate the final values. Thirty-three or 82.5% improved (below the diagonal); five or 12.5% were unchanged; two or 5% worsened. More importantly, there's even considerable variability within the group which improved. There are several possible reasons for such variations. Conceivably, all participants did not cooperate equally. Also, there may be differences in metabolic state. The point of interest here is whether this variation is predictable through a study of lipid metabolism.

At both visits, serum cholesterol was measured. The scores ranged from a low of 144 to a high of 256 mg%. Figure 5 portrays the initial (on the abscissa) and final (on the ordinate) serum cholesterol scores for the forty subjects. On the basis of (until recently) traditional standards of 150-250 mg% (represented by the largest rectangle) three of the group could be considered pathologic. An examination of the mean gingival scores (Table 2) at the initial visit shows that the three with the pathologic cholesterol scores (line 2) have a mean gingival rating of 0.67; those within the physiologic limits of 150-250 mg% (line 1) an average of 0.58. Thus, it seems that the more physiologic lipid pattern parallels the healthier gingival score. At the second visit, the trend is the same. The individuals with the pathologic values show a higher mean gingival grade (0.47 versus 0.37).

There's increasing evidence that the present physiologic limits are too broad.[16] On this assumption, the smaller squares delineate progressively more restricted acceptable limits (160-240, 170-230, 180-220, and 190-210). Table 2 summarizes the mean gingival scores in the light of these progressively more narrow norms. Several points warrant particular note. Firstly, in all instances in the initial visit, the mean gingival score within the rectangle (presumably representative of more physiologic metabolism) is lower than outside the square. Thus, 0.58 versus 0.67 with limits of 150-250 mg%; 0.46 versus 0.60 in the case of 190-210 mg%. Secondly, the smallest rectangle (representative of the most narrow limits of 190-210 mg%) parallels the lowest mean gingival score (0.46), line 9, which most closely approaches zero, the most optimal gingival state. Thirdly, at the second visit, the pattern is essentially that described above under the first item, namely, the mean gingival score within the rectangle is lower than outside. The next most desired gingival score (closest to zero) is found associated with the most rigid serum cholesterol standard of 190-210 mg%. Lastly, the pattern here for gingival state and cholesterol is precisely that earlier described with blood glucose (Table 1) and gingival state.

The critical point is that, once again, we have the extraordinary opportunity of examining a problem (gingival pathosis) on the right in terms of the pluses and minuses on the left. It appears that one of our most significant negative factors is the refined carbohydrate food stuffs. It is also apparent from this demonstration (supported by much in the literature) that the elimination of the simple sugar foods contributes to a more homeostatic lipid picture as judged by serum cholesterol. And so, here we note that, by adjusting the pluses and minuses (on the left side of the formula) salutory changes follow on the right.

The Bigger Picture

Up to this point we have tried to describe the role of the positive and negative factors (on the left side of the equation) which contribute to health/sickness on the right side of the formula. The examples have been straightforward and emphasize the measurability of the phenomenon.

The questions now to be resolved are: (1) Can one view other diseases than oral pathosis in terms of pluses and minuses, and (2) Are the positives and negatives in oral disease the same or similar to those in these other areas (cancer, heart disease, arthritis)?

A study was done of the early and subtle cardiovascular complaints (elicited from the Cornell Medcical Index Health Questionnarie, CMI). Additionally, the daily total, refined, and percentage refined carbohydrate consumption was measured. Finally, in these same 74 dental practitioners and their spouses, thiamine (vitamin B_1) was appraised. The study, albeit epidemiologic and therefore correlative (not with intervention), suggests a greater frequency of cardiovascular symptomatology in relatively older persons who consume arbitrarily higher quantities of carbohydrate, and especially refined, foodstuffs.[17] The experiment also emphasized a greater frequency of heart and blood vessel pathosis in older persons consuming marginally lesser quantities of vitamin B_1.[18] Finally, the significance of minuses (refined carbohydrates) *and* pluses (thiamine) is heightened by the greatest frequency of cardiovascular responses occurring in subjects consuming *smaller* quantities of vitamin B_1 and generally *higher* amounts of processed carbohydrate foodstuffs.[19] In extrapolation, two points are evident. Diseases in general can indeed be viewed in terms of pluses/minuses. Not demonstrated here, but evident from the literature, the positive/negatives for stomatologic disease are the very same as for heart conditions.

But this is not the end of the story. As we pointed out earlier, while the buzzwords like risk factors and odds ratios are widely used, their definitions leave much to be desired. This is amply borne out by the deliberations of the National Research Council:[20]

> ... Despite the fact that risk assessment has become a subject that has been extensively discussed in recent years, no standard definitions have evolved, and the same concepts are encountered under different names ... We use risk assessment to mean the characterization of the potential adverse health effects of human exposures to environmental hazards ... The term risk assessment is often given narrower and broader meanings than we have adopted here ...

And so what is meant by narrower and broader meanings? For one, the emphasis has been largely on negative factors. Also, practically no attention has been accorded the flipside, the positive and protective elements. Third, there is rarely any discrimination between primary (possibly causative) versus secondary (correlative) considerations. Finally, rare mention is made that risk factors are better expressed as curvalinear (parabolic) rather than as linear patterns.[21]

Apropos, we here at the University of Alabama Medical Center in 1969-1970 studied 391 dentists and their spouses in a survey in which a comparison was made of reported cancer versus nonfasting serum cholesterol concentration. First, and foremost, we discovered that the relationship was not linear but curvalinear. In other words, the greatest incidence of reported cancer occurred at both extremes, hypo- and hypercholesterolemia. The least evidence of cancer correlated with a relatively narrow range of blood cholesterol. The findings which we reported in the August 1971 issue of the *Journal of the American Geriatrics Society*[11] showed, in 45+ year olds, the least number of cases of cancer (10%) paralleled a serum cholesterol range of 210 to 240 mg%. The greatest number of cancer cases, actually 30%, was noted in those persons with a blood cholesterol below 210 mg%; 26% of those with high blood cholesterol reported cancer. Here we demonstrated the possibility that blood cholesterol, at both ends, parallels cancer.

Approximately ten years later, Bo Peterson, M.D., and his colleagues from the Departments of Preventive Medicine and Pathology at the University of Lund and the Malmo (Sweden) General Hospital reported 86 deaths which occurred from zero to five years after a screening survey of 10,000 middle -aged men in Malmo. The mortality distribution confirmed the parabolic pattern, one at the higher and the other at the lower end of the blood cholesterol scale.

Finally, it should be evident that, in our discussions the definitions of what constitutes pluses and minuses are more clearly defined than generally held.

Summary and Conclusions

First, it is highly desirable to recognize and utilize the fact that health/sickness can be expressed in arithmetic terms. Secondly, this allows the "final diagnosis" to be viewed by classical descriptions as well as degrees of independence. Next, the specific items which go to make up the ecologic formula seem to be best conveyed by pluses and minuses. These elements identify those factors which contribute to health versus the vectors which encourage illness. It is especially noteworthy that a "plus" for one part of the body seems to also be a "positive" for all other bodily functions. It is also necessary to accept the fact that pluses for one disease or condition are likely the very same positives for most if not all other pathologic states. Also, while not discussed in this report, these positive/negative vectors can act directly upon the human organism or indirectly by altering the internal milieu. Finally, utilizing this classification system suggests that the fundamental contributing factors to all health/sickness centers about lifestyle, meaning the air we breathe, the water we drink, and the food we eat.

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