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Modern epidemiology and its discontents

O mal-estar na Epidemiologia moderna

ABSTRACT

The goal of this article is to present a snapshot of an ongoing debate within epidemiology, pitching opposing sides in the struggle to define the path it should follow in the years to come. The debate among epidemiologists in the mid-90s pitted those who defended the idea that epidemiology should necessarily deal with a wide context against those who believed that science and public health are better served by focusing on the individual level. Ian Hacking's concept of styles of reasoning was used as a theoretical tool. The literature was reviewed using a core set of articles as an entry point, seeking articles that cited them, and then back-tracking the citations of the resulting set in the Scopus database. The main arguments are presented according to levels (ontological, epistemological, axiological and pragmatic), in order to show an even deeper disagreement, in the very conception of science and its relation to social issues and public policy.

DESCRIPTORS: Epidemiology. Public Health. Science. Knowledge. Review.

RESUMO

O objetivo deste artigo é apresentar o debate em curso na epidemiologia, evidenciando lados opostos na luta para definir o caminho nos próximos anos. Discussão entre epidemiólogos em meados dos anos 1990, que defendem que a epidemiologia deve necessariamente tratar de contexto amplo contra aqueles que acreditam que a ciência e a saúde pública são mais bem servidas focalizando o nível individual. O conceito de estilos de raciocínio de Ian Hacking foi usado como ferramenta teórica. A literatura foi revisada usando um conjunto nuclear de artigos como ponto de entrada, buscando os artigos que os citaram, e então seguindo as citações do conjunto resultante na base Scopus. Os argumentos principais, de acordo com níveis (ontológico, epistemológico, axiológico e pragmático), foram apresentados a fim de mostrar uma discordância ainda mais profunda, na própria concepção de ciência e da sua relação com questões sociais e políticas públicas.

DESCRITORES: Epidemiologia. Saúde Pública. Ciência. Conhecimento. Revisão.

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INTRODUCTION

Epidemiologists have over time divided themselves, in general terms, into two camps. One side concentrates on the proximal aspects of the health-disease process, whereas the other emphasizes the broader context. Depending on how it is framed, this argument could be retraced as far as the original contributions of Engels and Virchow to theories of social determination of disease. However, our chronological framework is narrower. Since the formal establishment of epidemiology as a discipline, with courses, departments, professors, curricula and publications early in the 20th century, the proximal view became increasingly dominant, though not uncontested.[6] From the 90s onwards, the articulation of a new version of the broader contextual vision spearheaded a shift in the discipline which continues to this date. This is the period we are dealing with in this article. However, within the proximal view camp and during that time frame there has been a considerable amount of internal dissension by smaller groups of epidemiologists who believed the discipline should be more integrated with molecular biology, or who, to use Pierce's expression, were "merely disgruntled about epidemiological findings".[46] This, however, is not our main focus.

The context versus proximal debate involves more than theories, encompassing worldviews that set the stage for the development of theories themselves, and the deployment of techniques and methods as well. Resonating with Kuhn's concept of paradigm[31] and Ludwik Fleck's notion of 'thought style',[14] Ian Hacking's 'style of reasoning' seems appropriate to cast the context versus the proximal debate within epidemiology, as the tension between two contrasting styles of reasoning. Styles of reasoning represent particular ways of thinking, seeing and practicing and involve formulating propositions that are intelligible within a particular style. Styles of reasoning are "self-authenticating"[18,20] since they establish the criteria of evaluation by which they are judged as well as bring into being the objects they are supposed to study.[19,20]

This study aimed to present a snapshot of an ongoing debate within epidemiology, pitching opposing sides in a struggle to define the path it should follow in the years to come.

HOW TO APPROACH A DEBATE

Science thrives on debates; but not all debates take place at the same level. Arguments can be about specific findings, on whether an association between a given exposure and a given outcome can be considered a fact or an artifact.[33] This kind of debate frequently involves discussion of methods, in the sense of whether adequate methods were chosen and/or deployed. More rarely, the whole enterprise of inquiry is brought under critical examination; it is no longer a matter of discussing findings and methods but the general framework within which the latter operate to produce the former. When this kind of debate grows in importance it may signal a confrontation of different styles of reasoning.

Approaching this sort of discussion through the literature is not as straightforward a proposition as it may seem. Keywords do not always reflect the core issues in the argument, and the crossfire of a polemic does not always retain an orderly account of citations between participants of a debate. Dates of publication do not necessarily reflect the actual order of writing. Different journals have different periodicity. Much of the argument can happen in venues other than printed articles, such as meetings or symposia. In our references, there is indication that this was indeed the case in this debate.

We resorted to both bibliographic database searches and poring over citations in order to arrive at a core set of articles that would reflect the overall tenor of the debate. We chose a core set of articles[24,42,43,45,63,64,66] that were published in the mid-to-late 90's, which shared common traits of a wide critique of risk-factor epidemiology. We searched the Scopus database for articles that cited them in roughly that same period. In order to arrive at a set of articles that would allow at least an approximate view of the ongoing discussion, we independently went over the whole list of articles produced from the database query. We selected only those that actually engaged the main arguments, being theoretical reflections on the role and development of epidemiology, arriving at a smaller number of articles. We perused the cited references of that group, including those that matched the same criteria, arriving at a final set of 47 articles. We analyzed the resulting set of papers trying to elicit and synthesize the main positions and arguments in the debate.

THE RUN-UP TO THE DEBATE

A full account of the history of epidemiology as a discipline is beyond the scope and purpose of this paper. Nevertheless, we would like to mention just one previous period in the history of the discipline, characterized in similar terms by a number of authors:[28,44,67] The growth and eventual establishment of risk factor epidemiology from the post-war period onwards, culminating with the so-called "Modern Epidemiology" as the dominant version of the discipline in the 80's. Following changes in the prevalence of disease in the populations of industrialized countries, a certain degree of hostility to progressive social thinking in the context of either the cold war or the forced neoliberal "consensus", and the growing

availability of technical means (computers), epidemiology concentrated on the search for risk factors associated with chronic-degenerative diseases, developing an increasingly sophisticated set of methods that relied heavily on complex statistics. A new generation of researchers, PhDs with mathematical backgrounds, rose to prominence, in contrast to the preceding era, when MDs committed to public health predominated. The publication of a group of very influential books, like Miettinen's, Kleinbaum's and Rothman's would mark the apogee of that epoch.[44,67] Early examples of discontent with mainstream epidemiology, however, can be found in the attempts by Carol Buck to shore epidemiology up with popperian philosophy,[5] and in the reaction that followed, including Susser's "Thought Tormented World".[62]

However, the context had changed significantly a decade later. The effects of disastrous economic policies based on neoliberal orthodoxy ("structural adjustment programs") on human lives became increasingly difficult to ignore, and parallel to that, paradoxically, the success of modern epidemiology itself seemed to bring it closer to its limits. The latter aspect is exemplified by an article published in 1995,[68] authored by a science writer who interviewed several prominent epidemiologists, all associated with risk-factor epidemiology. As a group, the interviews seemed to indicate that the discipline, as practiced then, was reaching its limits. The more significant risk factors had already been identified, and the ones that were being uncovered were weak enough to make it difficult to distinguish from spurious associations. Although some of the interviewees tried later to distance themselves from the most radical implications of Taubes' article, or shift the blame to the press and how it reports scientific findings, none went as far as to totally disavow the report.[70,71,77]

THE DEBATE

We can divide the epidemiologists in the latter half of the 90s into two groups: one arguing for a broader view of the objects and ideas that should be contemplated in epidemiologic research,[24,25,42,43,45-47,60,63,64,78,79] the other emphasizing a strict risk-factor approach, more concerned with putting Epidemiology on solid statistical grounds.[48,53-57,71,72,76] We can find a core set of similar critiques (in the first group) and responses (in the second), albeit with important individual variations within each group. Other authors were already seeking to methodologically develop the approach proposed by the critics[8-10,22,23] or elaborating its implications for public health[2,39,40,49] but not necessarily engaging in that specific debate.

One of the problems in reconstructing the discussion is that arguments operate on different levels, that, although inter-related, have their specificities as well, and it is not uncommon to see the authors sliding between those levels in their discourse. In the articles we selected, we found arguments that could be classified, for didactic purposes, as (a) ontological, dealing with non-testable assumptions of how the world is; (b) epistemological, which discussed how to produce reliable knowledge in epidemiology; (c) axiological, concerning whether research should be "neutral" or valued-oriented; and (d) pragmatic/utilitarian, about the utility and application of the produced knowledge (or not) (Table).

The overall argument of the critique can be summarized as follows: risk factor epidemiology operates under an atomistic metaphysics, implying that the universe can be understood as a vast mechanism composed of elementary parts. This leads to an epistemological approach to the objects of inquiry that disassembles them into elementary components and studies their articulations in isolation. Its practitioners believe in a science that is objective and neutral, that should not be "contaminated" with political considerations, and whatever use the knowledge they produce may have, it is separated from the research enterprise, which is an end in itself. Methods are emphasized to the detriment of theories, and are reified as means to achieve reliable knowledge. The narrow focus on the individual level of the processes underlying health and disease leads to the exclusion of important determinants at the population level, and consequently misses the opportunity to propose measures at that level, which would be inherently more efficient. The Table shows a summary of their critique and alternative propositions.

In addition to this generic, shared kernel, different authors emphasized specific aspects in their articles. Wing states that some of the confounders in risk factor epidemiology could become essential aspects of the context.[78] Krieger emphasizes what she considers a lack of theory in that kind of research, and states that it would be important to have new guiding metaphors that could replace the venerable web, proposing a combination of a fractal structure to represent biological processes,

Table. Synopsis of the arguments of the critics of risk factor epidemiology.

Argument	Critique	Proposition
Ontology	Atomistic/ individualized	Holistic
	Classical linear (multi) causality	Interactions
Epistemology	Reductionist/ analytic	Ecological perspective/ synthetic Reflexive
Axiology	Objectivity of science	Socially committed science
Pragmatics	Knowledge is an end in itself	Epidemiology as a key Public Health resource

from the molecular to the ecological, with a scaffolding standing for the social processes.[24] Susser & Susser make use of the kuhnian framework to describe the history of the discipline, and cast both the critique and alternative view as competing paradigms.[63,64] They propose the metaphor of the Chinese boxes as a guiding principle for the new paradigm, acknowledging that it would require new techniques and methods to be fully achieved. Despite the idea of nested hierarchies represented as "boxes", Susser & Susser emphasize the importance of systems and multilevel approaches ("multiple interactions between and within levels".[64] Pearce adds that risk factor epidemiology leads to "blaming the victim", i.e., placing the responsibility of living under higher risks exclusively at the feet of the affected individuals. He makes the strongest criticism on the distancing of epidemiology from public health; he states that an epidemiologist cannot be "too political" – a decision not to study socioeconomic factors is a political decision to focus on what is politically acceptable, adding that epidemiology was being reduced to a set of methods for measurement of health and disease-related issues.[45] McMichael emphasizes the temporal dimension, stating that modern epidemiology has become a "prisoner of the proximal", not only in terms of the overall model but in terms of focusing only on short-term processes.[43] Of all the critics, he most clearly makes the case that the problem of modern epidemiology is not doing risk factor research, but doing *only* that. Finally, he also makes a clear case for the application of a systems theory based approach: "How epidemiologists relate to that upstream category of question is influenced by whether we perceive the distal determination of disease as being part of either a linear causal chain or a systems-based causal web. (…) Causal processes within this web are not necessarily linear and sequential, but may involve interactions and feedbacks".[43]

On the other side of the debate, which defended a narrow risk-factor approach, the authors seem to agree with the critics' characterization of risk factor epidemiology, but disagree that this represents a problem: "there is no denying that epidemiologists have progressively concentrated on the details of causal mechanisms. The only surprise to us is that anyone would regard this preoccupation with causal mechanisms as a problem".[54] They defend that empiric "atheoretical" data gathering and interpretation, with emphasis on *methods*, is (a) scientific; (b) what can provide answers when other disciplines cannot. Even without knowing biological mechanisms that would explain links, risk factor epidemiology has provided evidence that led to actions which decreased disease (e.g., tobacco): "even without a clear understanding of mechanism, such observations provide the basis to modify exposures in order to prevent disease";[55] "In fact, the value of epidemiologic evidence for decision-making may be the greatest when other biomedical disciplines have the least to offer".[55] They state that epidemiologists should not be "activists". This would compromise the objectivity/neutrality of science: "we maintain that epidemiology best contributes to public health goals through rigor and by striving for the ever-elusive goal of objectivity, Mixing scientific and activist roles not only threatens the validity of epidemiologic science but reduces its benefit to public health".[57] They believe that science is not bound by a requirement of applicability; as scientists, epidemiologists should not be burdened by this kind of demand. "If an astrophysicist can study the origin of the universe without apology, should an epidemiologist have to apologize for work that is so practical?".[54]

There are also some specific variations among this group. Rothman is particularly keen in affirming that policy considerations do not belong in epidemiologic articles: "we want readers (...) to be able to focus on a critical examination of the science without confusing the issue with policy questions".[53] Reacting to a Lancet editorial,[49] he and his collaborators state that "accusations have been mounting that epidemiologists have abandoned their public health mission of being 'physician-scientist' to society in favor of studying the scientific arcana of disease causation".[54] They consider that two "accusations" were being made: "epidemiology is too individualistic" and "epidemiologists need moral and political fiber"; and respond to those stating that upstream inference is less secure and intervention at that level "may be" less efficient than closer to disease occurrence. Poole & Rothman,[48] commenting on a later article,[65] tone down considerably the counter-critique, proposing an armistice with Susser et al stating that while they are right in their demand for a more comprehensive epidemiology, in their proposal there is room for risk factor epidemiologists to proceed as they always had. They reserve the harsher criticism for Krieger[24] and Pearce[45] and others; Krieger & Ziegler[25] and Shy[60] are characterized as defending a macro-only approach ("social production of disease theories") and Vanderbrouke as defending a micro-only approach,[74] implying that their position would be the reasonable middle.

There is some disagreement on whether epidemiology is[72] or not[57] a basic science for public health, as well. Savitz et al deny that epidemiology is a basic science of public health,[57] and affirm that the latter is better served by the former when epidemiologic research focuses on producing evidence of specific (i.e., at the individual level) associations between risk factors and diseases. They propose a clear division of labor between epidemiologists and public health workers, who would use the evidence to advocate for adequate public policy. They stress the importance of accurate measuring as a means to reduce uncertainty in the evidence, which would better serve the design of policy interventions.

While there are some Braudelian, *longue durée*, threads in this debate, it signals some important changes and its originality should not be underestimated. The marked differences in various approaches that place the emphasis on context as a common denominator is clearly depicted in Krieger's book.[28] It would not be possible for the latter to propose a fractal-based analogy before a body of knowledge and a rich imagery about fractals became available in scientific discourse; the references to "complex systems"[23] rely on more recent work on complex adaptive systems; invocations of functionalist or behavioral thinking in the social sciences is radically different from a dialectic vision,[45] and, more obviously, the critique of risk factor epidemiology once it becomes dominant can point to its limits in a way that was not possible in earlier conjunctures. It is the triumph of that approach that made its shortcomings more clear. The systematic *ensemble* of those criticisms, couched in a significantly different conception of science (itself based on philosophical developments available only in the late sixties and previously not mentioned in similar debates), marks a singular and relevant moment in the recent history of epidemiology.

A DEEPER DISAGREEMENT

Participants sometimes talked past each other as often happens in scientific controversies. The critique that advocated a new theory, metaphor or paradigm was understood as an either/or proposition with regards to the techniques patiently developed under the aegis of risk-factor epidemiology. More often than not the call to embrace a wider *worldview* was misunderstood as an invalidation of *methods* and *findings*.

Taking aside the obvious differences visible in the articles discussed, there seems to be a deeper, more fundamental level of disagreement between the two sides, in their conception of what science is and how it should work. Deep divergences in the ontological, epistemological, axiological and pragmatic dimensions seem to indicate an incommensurability[32] of competing styles of reasoning.[20]

The critics of the status quo explicitly subscribe to a more contemporary philosophy of science that does not assume an absolute separation of facts and values, that relies on history instead of prescription of how science should be and that embraces political positions as part of any research that involves human populations.[7,33,59] The traditional view embraced by the risk factor epidemiology camp, however, seems to assume a pre-20th century view of science as a mirror image of "reality" that considers objectivity as an absolute, and that for this reason, concentrates on methods and eschews social and political "contamination".[51,52] One would be hard pressed to find a contemporary philosopher of science who would underwrite any proposition of "atheoretical" research, for instance.

If we consider those positions as derived from different styles of reasoning and take into account the self-vindicating aspect of such styles,[20] the apparent impermeability of each side to each other's arguments is hardly surprising. This raises an issue, pointed out in a critique of Hacking's point of view:[50] if styles of reasoning were indeed impervious to change, how to explain their demonstrable evolution over time? First of all, as Hacking[18] explains elsewhere, his concern when he began writing about styles was not so much with the changes in scientific disciplines, as explored by authors like Kuhn and Popper, but their large areas of stability. Secondly, resistance to change does not mean success in resisting as implied in the argument. As Fleck (another important reference in Hacking's work) discussed, resistance to new thoughts is an active process that nevertheless progressively recedes from finding such ideas unthinkable to attempts to describe them within the framework of the prevailing conceptions.[14] The next step in this process would be finally having a change or replacement in the style of reasoning, even if complete substitution might only happen after a generational change, as Kuhn remarked with regard to paradigms.[30]

THE AFTERMATH

New versions of the larger debate have erupted occasionally since the 90's,[16,17,38,41,61,73,75] and it would be incorrect, even irresponsible, to claim that it has been settled. That is one of the risks of dealing with a historical reconstruction of the recent past.

The first decades of the 21st century also witnessed a flourishing literature that took up the critics' propositions and developed them further, both theoretically and methodologically.[4,10-13,26,27,69] Two articles, in particular, seem to characterize the growth of the critical point of view within the epidemiologic community. The first comments on (then) recent changes at the NIH, stressing how it was displaying an increasing commitment to multilevel studies of health.[1] The second is a 2005 article that resulted from a discussion that took place in the 2002 APHA meeting, involving 12 leaders of epidemiology associations, who discussed the future and challenges of epidemiology in this century.[15] Despite its conciseness, it is a very comprehensive document; among the many statements it makes, three have direct bearing in our discussion: (a) that the advancement in other fields, especially molecular biology and genetics at one extreme and ecology, social science and public policy at the other, offer the chance to open the "black box"; (b) that a systems approach should be increasingly adopted, given the importance of both context and ecology, and this is tied to "the ultimate goal of all epidemiologic research: planning interventions to reduce the occurrence of disease and enhance the public's health."; and (c) that epidemiologists, as researchers and public health professionals, have a duty to assist the development and

implementation of policy based on sound information. This could be read as an endorsement, across the board, of the theses defended by the critics of the *status quo*.

The historical development of Epidemiology cannot be entirely attributed to the internal dynamics of the discipline. Kuhn[29] references *en passant* certain domains of knowledge that would be less likely to achieve a certain degree of "insulation" from the general societal environment, among them, medicine. If we extend "medicine" to include the health sciences, epidemiology included, this would be a reason why the crisis-revolution pattern might not directly apply. Given the constant pressures from society at large, the kind of transition driven mainly by the internal dynamics of a discipline would be less likely to take place, or at least, clearly perceived. Still according to Kuhn,[30,31] the social sciences do not fit the single paradigm model, and possibly never will;[30,31] given the proximity of epidemiology and the social sciences, this characterization could also apply to the former.

Epidemiology has gone through some important changes as a discipline in recent years. The new social epidemiology grew considerably in importance, with an increasing number of publications, both in article and book format.[28] It would be presumptuous to propose that the mid-90's debate decided a controversy that in a sense is still being played out. There were also important developments in the interface of genetics and epidemiology in the same period,[3,21,58] and even critics of risk factor epidemiology admit that it is still dominant;[37] despite the growing number of articles and books dedicated to social epidemiology, their methodological approaches are still dominated by that model. The new methods that would be more in line with the critical style of reasoning are still in their infancy, their contribution yet to mature.[36]

The relevance of the critique formulated in the mid-90's seems clear to us. As Lillienfeld & Lillienfeld wrote,[35] public health and epidemiology need to constantly nourish each other. A conception of epidemiology disconnected from social and political demands will not be able to face the challenges of a global public health, which include issues ranging from new health risks posed by recently developed technologies to claims for social justice.

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