

PUBLIC HEALTH PAST AND PRESENT

Analysis of social epidemiology research on infectious diseases: historical patterns and future opportunities

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Background: Despite the many triumphs of biomedical research over infectious diseases, human pathogens continue to impact profoundly populations deprived of social resources. Correspondingly, health researchers have advocated a social determinants approach to the study and prevention of infectious diseases. However, it is unknown whether this call has resulted in an increase in the number of studies examining social determinants of infectious outcomes.

Methods: Research on social determinants of infectious diseases was systematically quantified by assessing temporal trends in the published literature using MEDLINE, PsycINFO and ISI Web of Science.

Results: Results of the literature review spanning 1966–2005 show that socially related citations increased an annual average of 180.3 for neuropsychiatric conditions, 81.9 for chronic conditions, 44.7 for sexually transmitted diseases and 18.9 for non-sexually transmitted infectious diseases ($p < 0.0001$). Of the 279 publications found to employ the term "social epidemiology", 15 (5.4%) investigated infectious outcomes.

Conclusions: The results of the literature review suggest a paucity of social research on infectious diseases. There is a need for increased dialogue and collaboration between infectious disease epidemiologists and social epidemiologists.

Recent publications in the epidemiology literature have called for an evolution of theory and practice that would move the field from a focus on proximate, independent risk factors toward new paradigms of distal, interconnected determinants of disease risk. Example frameworks include "eco-epidemiological" constructions of nested systems,¹ socio-economic foundations of health,² predisposing childhood exposures³ and fundamental causes.⁴ The case for moving from identification of individual risk factors to broader population and societal-level contextual determinants of risk has been well argued in the literature^{4–8} and is an underlying motivation for much of the research in the field of social epidemiology.⁴ Explicitly or implicitly, the need for such discussions has been driven by the aetiological complexity of chronic diseases.^{8–9}

The importance of social factors as causes of disease has been well established.¹⁰ Indeed, questions of social causation of disease have been asked throughout the history of public health.¹¹ The ubiquitous association between socioeconomic status and health has been described,⁴ if not wholly explained;¹² the decrease in morbidity and mortality with increasing socioeconomic position is one of the most consistent relationships in epidemiology.¹³ A key difference identified by some social epidemiologists in their frameworks for understanding disease processes has been the focus on social conditions that promote or harm health, rather than on specific health outcomes.^{11–14} It has been argued that such inclusiveness is required by the fact that all diseases can be considered to be products of both biological and social processes.¹⁵ In practice, however, social epidemiology has focused historically on exploring aetiologies of non-infectious diseases. For example, in a review of social epidemiology, Renaud defines it as a "field of inquiry that regards the role of social and psychological factors in the etiology of chronic diseases",¹⁶ while McQueen concurs that social epidemiology is "a term which has recently come into favor to describe research concerned with social factors in the etiology of chronic disease".¹⁷

It is clear that social, political, behavioural and environmental factors shape the emergence and re-emergence of infectious diseases.^{18–19} Farmer¹⁹ has discussed the role of social

inequalities in the recent emergence of infections such as Ebola, AIDS and tuberculosis. Despite proven successes of biomedical research in discovering cures and treatments for many infectious diseases, human pathogens continue to emerge or re-emerge today and profoundly impact populations deprived of social resources. For these reasons, Farmer and others have advocated a social determinants approach to the study and prevention of infectious diseases at the population level.^{19–21} However, we hypothesised that most infectious disease research focuses largely on the proximate causes of the disease of interest (ie, microbial pathogens), at the expense of more thorough consideration of various types of distal contributors to the causal pathway. To test this hypothesis, we undertook a systematic review in order to quantify and summarise social constructs that have been examined as predictors of epidemiological studies of infectious diseases. In particular, we examined this hypothesis by assessing temporal trends in the international scientific literature on social causation of infectious disease outcomes indexed in major publication databases, such as MEDLINE and ISI Web of Knowledge.

METHODS

Three different search strategies were undertaken for this review. First, we conducted a search to provide a comprehensive list of studies that used the term "social epidemiology" and then cross-classified these articles by specific disease outcomes. Secondly, a search strategy was used to obtain studies based on specific social determinant key words (see table 1) and these studies were then cross-classified with specific disease outcomes. Our final search strategy was used to identify literature review articles on social determinants of health outcomes to assess the frequency of reviews that focus on social determinants of infectious disease outcomes. Each of these specific search strategies is described in detail below.

Social epidemiology key word search

We queried MEDLINE, PsycINFO and ISI Web of Science for all publications between 1966 and 2005 containing the term

Table 1 MEDLINE headings used to investigate quantities of articles referenced as dealing with social factors

Socially related MEDLINE headings	MEDLINE headings, by disease category			
	Non-infectious		Infectious	
Socioeconomic factors*	Neuropsychiatric	Chronic	Sexually transmitted	Non-sexually transmitted
Residence characteristics	Mental disorders	Heart diseases	HIV infections	Respiratory tract infections
Social environment	Substance-related disorders	Neoplasms	Sexually transmitted diseases	Diarrhoea
Social conditions		Cerebrovascular disorders	Hepatitis B	Tuberculosis
Social change		Pulmonary disease, chronic obstructive		Malaria
Social problems		Digestive system diseases		Poliomyelitis
Social welfare				Measles
				Diphtheria
				Pertussis
				Tetanus

* Encompasses other important subheadings, including "poverty", "income", "employment" and "social class".

"social epidemiology" in the titles, abstracts or keywords. The year 1966 was chosen as it marks the beginning of the inclusion of abstracts in the MEDLINE database. This search follows, but expands upon, an earlier exploration by Kaplan.²² To examine whether infectious disease research was included in "social epidemiology" literature, all results that had an English language abstracts were subsequently categorised according to specific health outcomes. Each abstract was read and outcomes were classified (by J.M.C.) into one of three groups: "non-infectious" (including "chronic" diseases and neuropsychiatric conditions among others), "infectious" (recognised microbe that is transmissible and considered the proximal causal agent) or "other" (literature not focused on a particular outcome). While recognising the false division of this classification (many "chronic" diseases are known to be associated with microbial infections, and infectious diseases may be chronic), these categories proved useful for comparative purposes. In the cases where the subject of inquiry was an infectious aetiology of a chronic disease, we chose to be conservative vis-à-vis our hypothesis, and classified the study into the infectious disease category.

Social determinants and disease outcomes search

Because research dealing with social factors may not self-identify as "social epidemiology", a second literature search utilised MEDLINE subject headings to compile articles generally discussing socially related factors from 1966 to 2005. We combined all citations indexed under socially relevant subject headings listed in table 1. To examine the health outcomes studied, we looked for citations cross-classified by MEDLINE as addressing some of the most important disease outcomes from worldwide morbidity and mortality estimates in the World Health Report (2002).²³ For comparison, we grouped these searches into neuropsychiatric conditions, non-sexually transmitted infectious diseases and sexually transmitted infectious diseases categories (table 1).

Reviews of social determinants and disease search

MEDLINE classifies each article in its database under numerous subject headings but highlights a few headings that indexers deem especially important with "focus" labels. To identify review articles specifically examining social determinants of health outcomes, we used MEDLINE and the "focus" option to return only those articles that MEDLINE classified as especially relevant to socially related subject headings, then additionally limited those results to review articles with abstracts. Abstracts are only available in MEDLINE beginning in 1975, so citations before that year were not considered. Because the "focus" option does not automatically include subheadings, we specified a search encompassing any article

indexed as focusing on the headings in table 1 and included the potentially relevant subheadings of "poverty", "income", "social class", "employment", "housing", "community networks", "social support", "civil disorders", "human rights abuses", "juvenile delinquency", "needle sharing", "race relations" or "urbanisation". Abstracts were used (by J.M.C.) to classify the resulting reviews that considered possible effects of social factors on occurrence of specific disease outcomes. Reviews of neuropsychiatric outcomes were excluded because social factors were often the outcomes as well as exposures of interest in such articles. Additionally, reviews of subjects not related to human health outcomes (eg, behaviours or policies) and the effects of social factors on medical care, treatment success or recovery were excluded.

RESULTS

Social epidemiology key word search

This search strategy returned 279 citations that used the term "social epidemiology". Our review of identified abstracts revealed that 40 (14.3%) of these reports did not focus specifically on health outcomes, and that 102 (36.6%) involved general discussions of social epidemiology, such as methodological discussions or analyses of all-cause mortality. The remaining 137 citations addressed the social epidemiology of various health outcomes. Fifteen of these 137 studies (10.9%) focused specifically on infectious diseases, 11 of which involved HIV/AIDS.²⁴⁻³⁴ The other four relevant infectious disease citations discussed gonorrhoea,³⁵⁻³⁶ varicella infection³⁷ and measles.³⁸

The temporal trend in social epidemiology research, plotted as the cumulative number of publications by year (fig 1A), and as the number of publications per each 5-year period (fig 1B) of publication, was similar to that published by Kaplan.²² However, the number of studies specifically dealing with infectious diseases rose more slowly compared with non-infectious diseases.

Studies examining social determinants and disease outcomes

Socially relevant subject headings contained 403 935 references. Although the chronic disease category had the largest number of publications in general (fig 2A), a higher number of neuropsychiatric citations were cross-referenced under socially related subject headings (fig 2B). The infectious disease category represented the smallest body of literature overall, as well as within socially related subject headings. Specifically, 26 792 chronic disease citations were cross-referenced under socially related subject headings (0.9% of all chronic disease citations from that period). Similarly, citations for 69 437 neuropsychiatric conditions (or 11.8%), 13 573 sexually

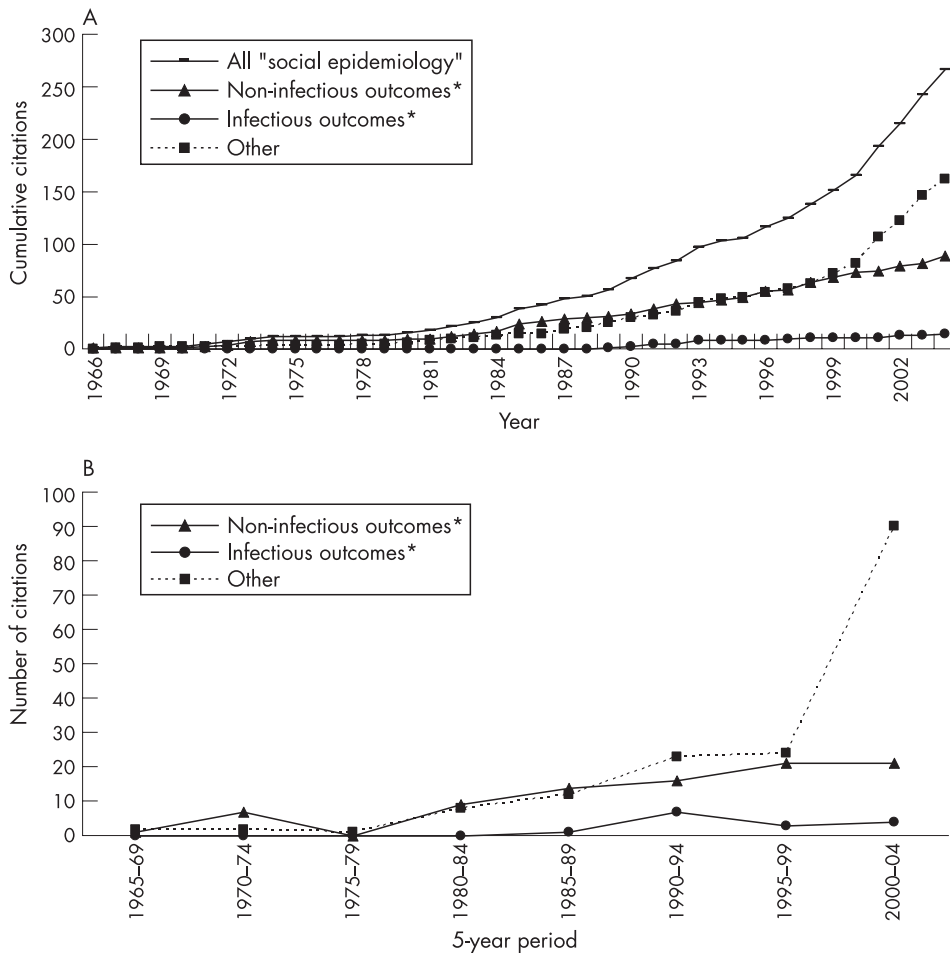


Figure 1 (A) Cumulative number of references to "social epidemiology", by year, in titles, abstracts or key words of publications on MEDLINE, PsycINFO and ISI Web of Science from 1996 to 2005. Papers focusing on specific health outcomes were classified into "infectious" or "chronic" categories,* while articles not focusing on specific disease outcomes are classified as "other". (B) Number of citations for "social epidemiology" in each category by 5-year period. Only citations from 1966 onward were included in the first 5-year interval.

transmitted disease (6.2%) and 6307 non-sexually transmitted infectious diseases (2.1%) were cross-referenced under socially related subject headings. Each year, on average, the socially related, sexually transmitted infectious disease literature increased by 44.7 citations, as compared with only 18.9 citations for non-sexually transmitted infectious disease. Both of these infectious disease categories were superseded by annual increases of 180.3 citations for neuropsychiatric conditions and 81.9 citations for chronic conditions.

Review articles on social determinants and disease

The search for socially relevant review articles returned 2455 citations. Our classification of the articles by the specific outcomes of interest (eg, "obesity", "asthma" or "tuberculosis") resulted in the identification of 162 reviews published between 1975 and 2005 that discussed the role of social factors in determining risk of specific disease outcomes. Among these reviews, cardiovascular outcomes, cancers and obesity were most represented, with 46 (28.4%), 25 (15.4%) and 20 (12.3%) review articles, respectively (fig 3). Infectious disease outcomes, including infectious aetiologies of chronic conditions, accounted for 44 reviews (27.2%). Of these, only two were systematic reviews.^{39,40} The majority of the identified review articles focused on HIV/AIDS. The types of social factors discussed in these reviews are depicted in table 2.

DISCUSSION

The three search strategies employed here were designed to examine critically the body of literature indexed in major publication databases exploring the role of social factors in causation of infectious diseases. The first search identified

articles using the key words "social epidemiology". These results demonstrated that the quantity of such publications has grown rapidly over the last three decades (fig 1), but also revealed that infectious diseases are largely absent from this body of literature. Of the 137 articles discussing the "social epidemiology" of specific diseases, 15 addressed infectious diseases, and only three of those discussed diseases other than HIV/AIDS. This initial search demonstrated only a small body of infectious disease research within the broad domain of "social epidemiology". It is possible that some articles that would have fallen under the rubric of "social epidemiology" did not utilise this term. For these reasons, we conducted several other search strategies.

We found that the lowest number of citations among all health outcomes that were cross-referenced under headings related to social factors was for non-sexually transmitted infectious diseases (fig 2B). However, it is difficult to draw conclusions from this finding since the non-sexually transmitted infectious diseases category also contained the fewest citations in general (fig 2A). The very large number of MEDLINE citations for all non-sexually transmitted infectious disease ($n = 6307$) made it impossible to evaluate whether each of these specific citations investigated the role of social factors in disease causation, or whether these reports considered the reverse effects of diseases on social or economic outcomes. The breadth of this search made it highly sensitive to social determinant research by including all research reports discussing the role of social factors in disease causation, but it was not specific; articles that dealt with social factors tangentially or examined the effect of diseases on social outcomes were also included.

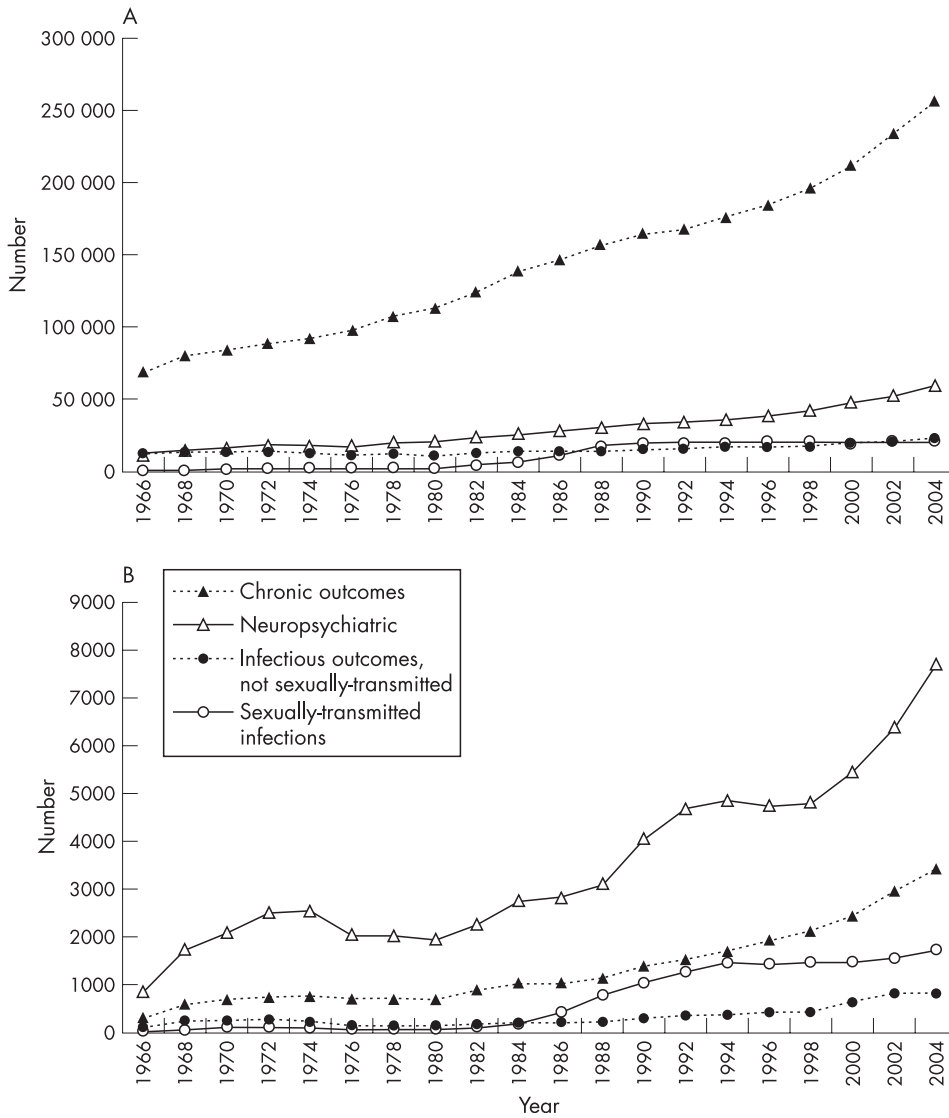


Figure 2 (A) Number of citations per year indexed in MEDLINE from 1966 to 2005 under subject headings related to important non-infectious, neuropsychiatric, infectious or sexually transmitted diseases. (B) Number of citations in the same disease categories additionally cross-referenced with subject headings related to social factors

Issues such as the ambiguous causal directionality of returned citations could not be resolved through quantitative MEDLINE searches alone. The large number of citations (403 935) cross-referenced under the subject headings in table 1 made it logistically impossible to examine individually whether each report dealt with the role of social factors in

influencing disease risk. Therefore, our third strategy involved evaluation of review articles. We chose to assess the topic of review articles as a search strategy for several reasons. First, review articles generally are designed to provide a summary of the current state of the research.⁸¹ Second, reviews of the scientific literature have the potential to be used for answering

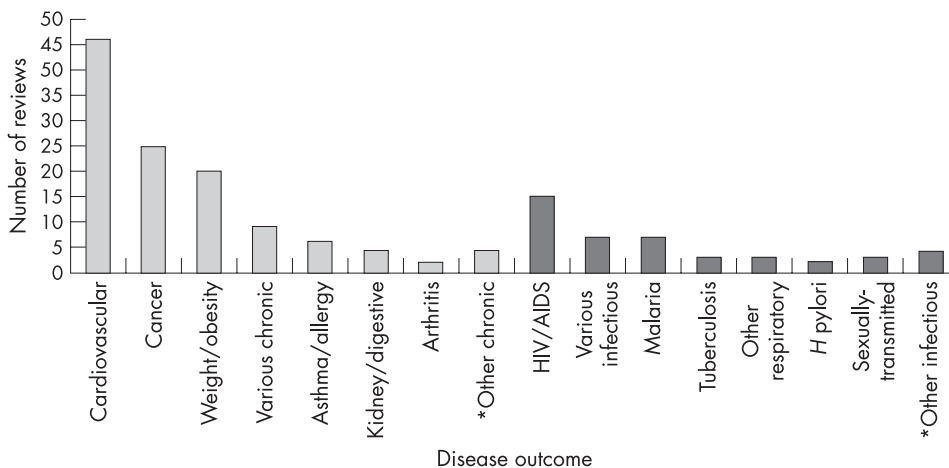


Figure 3 Number of review articles indexed in MEDLINE under subject headings related to social factors specifically involving social causation of disease, as of November 2005. Chronic disease outcomes are in blue and infectious disease outcomes are in red.

Table 2 Infectious disease review articles listed on MEDLINE as “focusing” on subject headings related to social factors as of November 2005, listed by outcome and social factors discussed

Social factor	Infectious disease	References
Status or empowerment of women	HIV/AIDS	41–48
	Infections	49
Political or macroeconomic	HIV/AIDS	43, 44, 50, 51
	Malaria	52
	Infections	19, 53, 54
Discrimination and cultural attitudes	HIV/AIDS	43, 47, 50
	Malaria	55
Drug use	HIV/AIDS	43, 47, 48, 50, 56, 57
	STDs	58, 59
Education	STDs	60
	<i>Helicobacter pylori</i>	40
	Infections	49
Poverty, social inequality, SES	HIV/AIDS	45, 47, 51
	Malaria	39, 61, 62
	TB	63–65
	Respiratory infection	66, 67
	Parasitic	68
	Hepatitis	69
	<i>H. pylori</i>	40, 70
Social trends and human behaviour	Infections	19, 49, 71
	HIV/AIDS	31
	Respiratory infection	67
Sanitation	STDs	[60
	Infections	53, 72
	Trachoma	73
	Parasitic	68
	Infections	49, 71
Social networks/social support/ psychosocial factors	Respiratory infection	66, 74
	STDs	59
Urbanisation and residence	Malaria	75, 76
	TB	65
	Plague	77
	Infections	78
Migration and instability	HIV/AIDS	44, 79
	TB	64
Theory of causality	HIV/AIDS	80

SES, socioeconomic status; STDs, sexually transmitted diseases; TB, tuberculosis.

relevant policy questions, and for decision making in public health and medicine.^{82–83} Interestingly, our search resulted in only 44 reviews discussing the effects of social factors on infectious diseases, of which 15 involved reviews of HIV/AIDS, and only two of these appeared to use a systematic search methodology (ie, using an explicit search methodology followed by appraisal of resulting articles). The paucity of available review articles involving infectious diseases other than HIV/AIDS supports the contention that such diseases are rarely studied in the context of social determinants. Given that systematic reviews generally aim to synthesise existing research and define future research agendas,⁸⁴ further studies that examine trends in the topics of review articles that focus on infectious disease outcomes are needed.

Like most systematic reviews, this investigation encompassed only literature indexed in large indices of publications commonly searched by biomedical researchers. MEDLINE indicates that it contains citations from approximately 5000 journals worldwide in 37 languages,⁸⁵ with about 22% of its citations having non-English abstracts.⁸⁶ Databases such as MEDLINE include only the most internationally visible research from journals selected by an NIH committee.⁸⁷ It remains possible that a body of literature on social

determinants of infectious diseases exists in the non-English literature or in smaller profile national journals not indexed by MEDLINE or ISI.⁸⁷ In context, then, these results indicate that within the publications encompassed by approximately 5000 most influential international journals examined here, such research is scant. It remains possible that these results are biased by the exclusion of non-English language abstracts. However, investigations of the magnitude of such biases in analogous systematic reviews indicated that they rarely cause reviewers to reach drastically different conclusion than if other languages had been considered.^{88–89}

We recognise other potential limitations to this review. First, it is certain that literature database searches alone will not find every relevant citation.⁹⁰ However, our purpose was to highlight trends in the literature, not to compile a comprehensive list of all social citations, and it seems likely that MEDLINE provides a representative picture of the state of epidemiology research. Second, our review only examined publications from the past four decades (and only since 1975 in search strategy three), yet a great deal of research into the role of social factors occurred before this time.⁶ While earlier work highlighted the importance of such factors and their associations with disease, the modern techniques and paradigms employed by social epidemiologists today are necessary to elucidate the mechanisms through which they act. Our findings suggest that such rigorous investigations are not commonplace for topics in infectious disease research recently published in major international journals. Finally, these analyses did not examine whether citations vary geographically. Future investigation of whether socially related research is evenly distributed among diseases afflicting industrialised or developing nations would be enlightening.

What forces may have shaped the trends that we observed? The small amount of “social epidemiology” as applied to research on infectious diseases other than HIV/AIDS may be the product of the historical evolution of the field of social epidemiology. Krieger⁹¹ traces the origin of the term “social epidemiology” to a 1950 article by Alfred Yankauer, with that phrase appearing more often within the epidemiology literature by the beginning of the 1970s. Nevertheless, development of the field of investigations during that period occurred at a time when infectious diseases were no longer widely considered to be important sources of mortality or morbidity in industrialised nations. For example, one of the first major addresses calling for a union of sociological frameworks with epidemiology occurred in 1969,⁹¹ the same year that Melvin Fox, a medical director from the Texas State Department of Health, testified to a congressional committee that, “The problem is that too many people, including physicians, consider tuberculosis no longer a problem”.⁹²

Similarly, historical transitions may have shaped trends in infectious disease research. During the first half of the 19th century, theories of miasma led to large-scale sanitation interventions in the physical environment that affected infectious agent transmission.¹¹ During this “sanitary era”,⁶ figures such as Edwin Chadwick and Rudolf Virchow emphasised the social conditions and economic factors linked to human health.^{6–93} Although such conceptions of the social roots of disease were highly successful in improving health through efforts such as better sanitation, they lacked the scientific underpinnings of the microbiological revolution that followed during the second half of the 19th century.⁶ The laboratory-focused investigations of microbiologists, and their subsequent identification of the “true” causes of infectious diseases, increasingly led to a focus on agent-specific prevention. Hence, research on broad-scale social approaches for reducing infectious diseases lost favour.

What this paper adds

- This systematic review article is the first to demonstrate quantitatively that research on social determinants of infectious diseases lags significantly behind that of non-communicable outcomes.
- Historical explanations for the observed trends are explored and the importance of increasing dialogue between infectious disease epidemiologists and social epidemiologists is discussed.

Policy implications

- Recognising the role of social determinants in transmission and risk of infectious diseases is one component of public health's stated goal of population-level disease prevention.
- Studies addressing economic contexts and the role of societal, community and structural determinants are needed to inform public health policy aimed at reducing social disparities in infectious diseases.

Today, social, political, behavioural and environmental factors are widely accepted as forces shaping emergence and re-emergence of pathogens^{18, 19} through, for example, their effects on conditions of refugees and migrants into previously unsettled habitats⁹⁴ and the expansion of global travel.⁹⁵ Despite the proven successes of biomedical research in discovering cures and treatments of infectious diseases, pathogens continue to emerge or re-emerge. Recognising the role of social determinants in transmission and risk of infectious diseases is one component of public health's stated goal⁹⁶ of population-level disease prevention,⁹⁷ encompassing the "why" as well as the "how" of disease causation.⁹⁸ Our examination of the international infectious disease literature reveals that focusing solely on such proximate elements may have led to exclusion of rigorous consideration of the more distal determinants that influence future transmission and evolution of both existing and new pathogenic threats to health.

This review indicates that research into the role of social factors influencing the aetiology of HIV/AIDS is far more advanced than that for any other infectious disease. Even in the HIV/AIDS literature, however, identification of the viral cause of disease led scientists to focus largely on microbial cures and medical treatment, rather than on social determinants and prevention at the onset of the epidemic.⁹⁸ Nevertheless, HIV/AIDS review articles have highlighted the importance of societal and community factors, structural and economic contexts, and cultural attitudes as factors that influence population patterns of risk. Although HIV is an unusually visible infectious agent within the industrialised world, its social roots run parallel to those shaping transmission for many other infectious agents, including those that are chief sources of morbidity and mortality in the developing world.

We hope that researchers studying other infections might consider the roles played by such factors in affecting disease risk and subsequently may adopt methodologies that would permit elucidation of these mechanisms. Although the results of our literature search of major international journals indicate otherwise, we believe these are urgent topics that need to be addressed for public health and medical policy decision

making. These results do not provide definitive proof that infectious disease research is more neglected within the domain of social epidemiology than elsewhere, but they do indicate that infectious disease researchers publishing in international journals have yet to adopt social epidemiology methodologies. An exclusive focus on microbial agents without consideration of the social context in which they are transmitted is analogous to research on the causes of cancer that focuses only on genetic mutations without considering how those mutations or microbes interact with and are caused by environmental factors. Social epidemiology has been described as "a fertile cross-roads where practitioners of diverse disciplines can meet and argue over their theories and assumptions;"¹⁴ we believe infectious disease research would benefit from increased participation in such a dialogue.

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