

mada Valley Alluvium, Hoshangabad Area, Madhya Pradesh (India). Records of the Geological Survey of India 113(6):159-172.

Theobald, W.

1881 The Siwalik Group of the sub-Himalayan Region. Records of the Geological Survey of India 14:66-125.

Evidence of a Jewish Advantage: A Study of Infant Mortality in Gibraltar, 1870-1959

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One of the major orientations of medical anthropology is toward the elucidation of the various ways in which patterns of health, disease, and death reflect the interdigitation of cultural and biological phenomena in human populations (Al-land 1966; Lieban 1977; Foster and Anderson 1978). Research into this question has ranged from the effects of acculturation on disease patterns (Neel 1970; Garruto 1981) to the relationship between specific social behaviors and unusual disease occurrences (Glasse 1967), and to the way the perception of a disease influences its distribution (Smith and Guinto 1977), to name but a few.

We approach the problem of biocultural interaction by comparing historic trends in infant death in the Sephardic community of Gibraltar to those of the rest of the civilian population. Earlier research has shown that the Gibraltar Jews displayed a lower infant mortality rate (IMR), deaths under one year of age per 1,000 live births, than non-Jews (Sawchuk and Flanagan 1979). Similar findings have been documented for other Jewish communities (see Schmelz 1971; Peritz and Tamir 1979; Abramson and Goffin 1979; Davies 1979). Long-term studies, reliable data on cause-specific mortality, and statistical testing of these

findings are noticeably absent, however (Schmelz 1971; Sawchuk and Herring 1984).

The purpose of this paper is threefold: first, to describe the secular trend in infant mortality in the Jewish and non-Jewish inhabitants of Gibraltar from 1870 to 1959; second, to identify the age and cause-specific nature of the observed mortality differential; and finally, to explain the temporally defined disparity in the infant death rates in the two groups.

The historical development of the civilian population in general and the Sephardic community in particular have been described elsewhere (Sawchuk 1978, 1980; Sawchuk and Waks 1983; Sawchuk and Herring 1984). The reader is referred to these for a more thorough discussion of the population and its setting.

Materials and Methods

Research since 1974 into the Sephardic community of Gibraltar has resulted in a comparatively large data base derived from religious and civil sources (Sawchuk 1980). A comparable data base for the non-Jewish residents was constructed from hand-transcriptions of the infant deaths recorded in the civilian death registers from 1870 to 1909, and from information contained in the Annual Report on the Public Health of Gibraltar from 1914 to 1959.

Three time periods were constructed so that major changes in the IMR could be evaluated over time: 1870-99 (period 1), 1900-29 (period 2), and 1930-59 (period 3). Neonatal (under 1 month) and postneonatal (1 to 12 months) mortality were assessed. Where sample size permitted, postneonatal deaths were further partitioned into deaths between 1 to 6 months and 6 to 12 months so that the age structure of infant mortality could be more precisely defined.

To identify more clearly the source of the infant mortality differential, cause-specific neonatal and postneonatal mortality rates were computed for each time period. The following leading causes of deaths were examined: (1) the diarrheal complex, including deaths attributed to

diarrhea and gastroenteritis; (2) the pneumonia/bronchitis complex; (3) the nutritional complex, including marasmus, inanition, anemia, and debility; and (4) "difficult dentition" or "teething." The remaining causes of death were assigned to a category designated as "other."

The synergistic effects of the first three categories underlie the weanling diarrhea phenomenon observed in developing countries (Latham 1975) and constitute the major source of the disparity in IMRs between developed and nonindustrial countries today (Klein 1980). To examine the possibility that this triad underlay the infant mortality differential in Gibraltar, diarrhea, pneumonia/bronchitis, and nutritional deaths were pooled into a single category. It will be demonstrated in the analysis section that deaths attributed to "teething" also belong in this category and that they were, in fact, deaths due to weanling diarrhea.

The G statistic, a log-linear test of homogeneity (Sokal and Rohlf 1969; Feinberg 1980), was used to evaluate the significance of the observed mortality differentials.

Analysis

Figure 1 depicts the infant mortality differential between the Jews and non-Jews of Gibraltar from 1870 to 1959. Owing to the relatively small Jewish sample, the IMRs were smoothed using ten-year moving averages. As Figure 1 shows, the Jews had consistently lower rates of infant death throughout the study period.

G statistic analysis (Table 1) indicates that the mortality differential was highly significant from 1870 to 1899 ($G = 10.73$, ldf ; $\alpha = .01$), that it remained significant from 1900 to 1929 ($G = 4.51$, ldf ; $\alpha = .05$), but that from 1930 to 1959 it was no longer statistically significant ($G = 0.73$, ldf ; $\alpha = \text{n.s.}$).

The common problem of underreporting of infant deaths in historical studies (Thestrup 1972; Knodel and Kintner 1977) does not seem to be the source of the observed mortality differential. As Table 1 shows, underreporting and/or overestimation of the age at death, indi-

cated by the low proportion of deaths under one month (see Knodel and Kintner 1977), occurred in both groups from 1870 to 1899. From 1900 to 1929, underreporting was confined to the non-Jews. The small number of Jewish deaths ($n = 6$) from 1930 to 1959 probably accounts for the low proportion of deaths under one month.

Both groups experienced a reduction in IMRs from 1870 to 1929 (Table 1). Among the Jews, infant mortality dropped by 21.5 primarily because of an overall reduction in postneonatal deaths. In the non-Jews the reduction in IMR was even more pronounced, with a decline of 33.0. The drop in this group was confined principally to the 6- to 12-month age category.

An even greater diminution in infant deaths took place from 1900 to 1959. Among Jews, the IMR dropped by 57.3 to reach a low of 30.3 infant deaths per 1,000 live births. The most marked improvement occurred in neonatal mortality. A more dramatic reduction of 76.7 resulted in an IMR of 42.0 among non-Jews. As in the previous period, survivorship improved primarily in the postneonatal group.

The information in Table 1 was also used to assess whether the mortality differential was influenced by breast-feeding behavior. Following Bourgeois-Pichat (1951), the slope of the line connecting cumulative infant mortality at six months and at one year was compared to the slope of the line connecting cumulative infant mortality at one and six months. It has been argued that a ratio above unity denotes a breast-feeding population, while a ratio below unity indicates a population using artificial feeding (Knodel and Kintner 1977). Since the ratios for the Jews and non-Jews are greater than unity, it would appear that breast-feeding was common to both groups. This finding is consistent with early medical reports that state that the majority of infants born in Gibraltar were breast-fed (Dansey-Browning 1913:13).

Cause-specific IMRs presented in Table 2 demonstrate that the relative advantage in infant survivorship among the

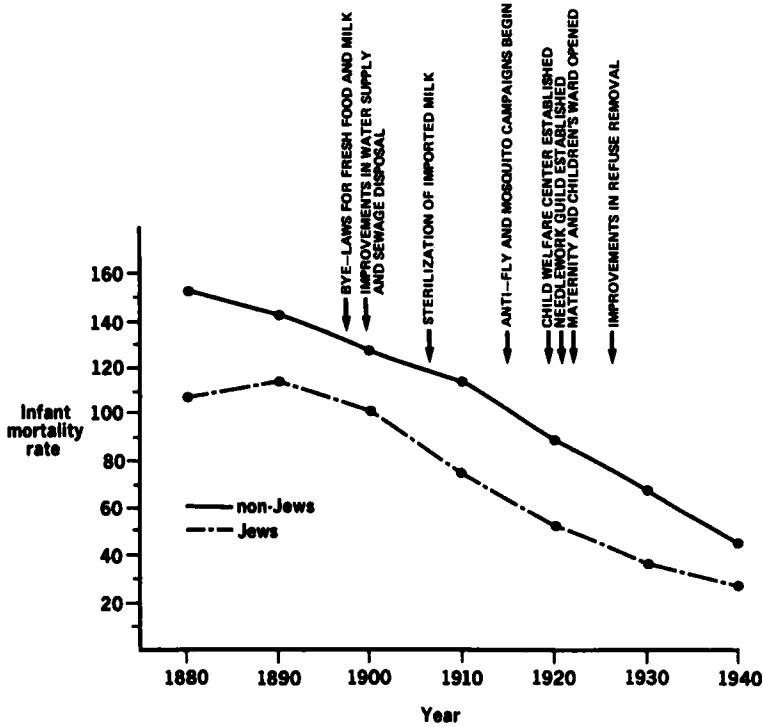


Figure 1

Sanitary-social reforms in Gibraltar and secular trends in infant mortality rates in the Jewish and non-Jewish residents.

Table 1

Infant deaths and age-specific infant mortality rates among the Jewish and non-Jewish residents of Gibraltar, 1870–1959.

Period	Died < 1 yr.	Survived ≥ 1 yr.	G test statistic	Infant mortality rate (per 1,000 live births)			Ratio of slopes	
				Total IMR	≥ 1 < 1 mo.	≥ 6 < 12 mo.		
1870–99 Jews (733)	80	653	10.73**	109.1	25.9	43.7	39.6	1.43
non-Jews (14,426)	2,188	12,238		151.7	27.8	57.1	66.8	1.84
1900–29 Jews (468)	41	427	4.51*	87.6	32.1	29.9	25.6	1.35
non-Jews (10,459)	1,241	9,218		118.7	30.6	45.3	42.7	1.48
1930–59 Jews (198)	6	192	0.73 ns	30.3	5.1	10.1	15.2	2.36
non-Jews (9,267)	389	8,878		42.0	22.1	10.5	9.4	1.42

**α = .01

*α = .05

Jews from 1870 to 1899 was due primarily to fewer deaths attributed to “difficult dentition” or “teething.” The “teething” death rate among non-Jews stood at 21.4

per 1,000 live births, a rate five times greater than that for Jewish infants.

Although the interpretation of “teething” remains controversial today (Mc-

Table 2
Cause-specific infant mortality rates (per 1,000 live births) by age group, 1870–1959.

Cause of death	< 1 mo.		1–12 mo.		Total	
	Jews	non-Jews	Jews	non-Jews	Jews	non-Jews
1870–1899						
Difficult dentition/ Teething	—	—	4.1	21.4	4.1	21.4
Diarrhea/ Pneumonia/ Bronchitis nutritional complex	9.5	10.5	39.6	44.1	49.1	54.6
Other	16.4	17.3	39.6	58.3	56.0	75.6
1900–1929						
Diarrhea/ Pneumonia/ Bronchitis nutritional complex	14.9	11.5	23.5	57.6	38.4	69.1
Other	17.1	19.1	32.1	30.3	49.2	49.4
1930–1959						
Diarrhea/ Pneumonia/ Bronchitis nutritional complex	—	1.4	10.1	13.8	10.1	15.2
Other	5.1	20.7	15.2	6.0	20.2	26.8

Keown, Record, and Turner 1975; British Medical Journal 1970, 1975; Kiple and Kiple 1977; Cohen and Walker 1979; Cohen, Hendricks, and Walker 1979), we view “teething” as a multifactorial disease complex that corresponds to weanling diarrhea (Gordon, Chitkara, and Wyons 1963). Weanling diarrhea is the product of synergy between enteric infections, malnutrition, repeated insults from infectious disease, and a poor weaning diet that sets up a vicious cycle of gastroenteritis/malnutrition, lowering overall disease resistance (Latham 1975; Jelliffe and Jelliffe 1978).

There are a number of reasons for drawing this conclusion. First, a detailed examination of the seasonal distribution of teething deaths from 1870 to 1899 indicated that the distribution pattern resembled that of diarrheal deaths (Figure 2). Second, analysis of 284 cases of teething deaths where a secondary cause was listed revealed that almost three-quarters of the latter were attributed to convulsions (35%), diarrhea (30%), and nutritional disorders (7%). Other studies have interpreted similar symptoms as nutri-

tional tetany (Kiple and Kiple 1977) and weanling diarrhea (Hansen 1979). Finally, Gibraltar’s medical officers consistently identified a number of ecological conditions that would predispose infants to weanling diarrhea: unsatisfactory and contaminated milk and water supplies, deplorable sanitation and scavenging systems, overcrowded and inadequate housing, and the domestic squalor endured by the poor (MacPherson 1892; Elkington 1901).

From 1900 to 1929, the decline in the non-Jewish IMR was due largely to a reduction in postneonatal deaths assigned to “other” causes (Table 2). The less pronounced decline in the Jewish IMR related principally to a fall in postneonatal deaths attributed to the weanling diarrhea triad. Although the magnitude of the mortality differential diminished from 1900 to 1929, Jewish infants continued to be significantly less vulnerable to the weanling diarrhea triad.

“Teething” ceased to be a major cause of infant death in Gibraltar after 1900. Its diminution relates, in part, to changing paradigms of disease causation associ-

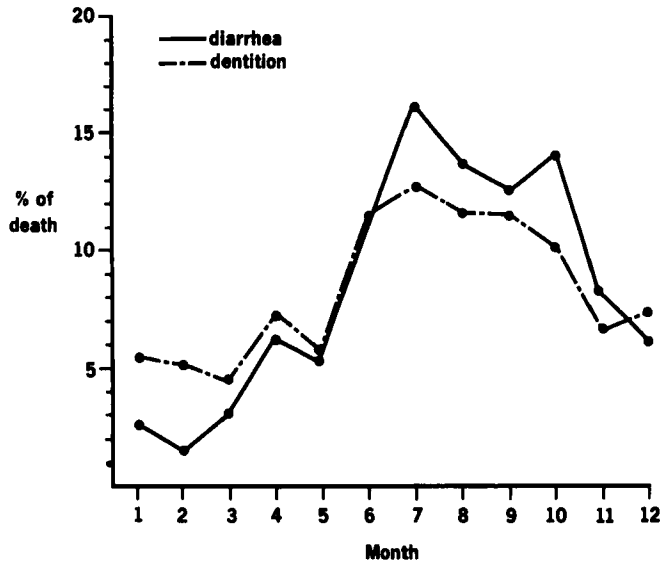


Figure 2
Infant deaths attributed to teething and diarrhea, 1870-99.

ated with the emergence of modern biomedicine. "Teething" was an acceptable, albeit controversial, disease category in the latter part of the 19th century (see Smith 1889; Neaderland 1952; Radbill 1965). By the early 20th century, however, its nonspecific and manifestational definition was irreconcilable with the new philosophy of disease specificity (one microbe = one disease). This affected the way in which teething was recorded as a cause of death in Gibraltar.

A comparison of hand-transcribed teething deaths and Gibraltar's published health reports indicated that even though Gibraltar physicians continued to certify teething deaths, these were subsequently reassigned to other categories in the published reports. Furthermore, the categories to which teething deaths were shifted depended on the personal tastes of the various medical officers. Consequently, the decline in teething deaths in Gibraltar is to some extent an artifact of shifting biomedical paradigms and of the subjective biases of the medical officers.

From 1930 to 1959, both groups experienced a considerable reduction in neonatal and postneonatal mortality. The greatest decline occurred in postneonatal

deaths attributed to the diarrhea, pneumonia/bronchitis, and nutrition triad (Table 2). Among the non-Jews, postneonatal deaths due to this triad fell from 57.6 to 13.8 per 1,000 live births over the two respective periods (1900-29/1930-59). While differentials in cause-specific mortality still persisted between the two groups, the disparity in total IMRs between the Jews and non-Jews was not statistically significant ($G = 0.73$, ldf; $\alpha = ns$).

Discussion

The progressive diminution in infant deaths in Gibraltar and the concomitant narrowing of the infant mortality gap between Jews and non-Jews are closely tied to the development and elaboration of biomedicine. Here biomedicine refers to the predominant medical theory and practice of Euro-American societies and to the distinctive system of ideas and practices associated with its presence (Hahn and Kleinman 1983).

Although the biomedical transformation of Gibraltar affected all Gibraltarians, its impact was relatively greater on the non-Jewish segment of the popula-

tion. We argue that a constellation of sociocultural features of the Jewish community significantly buffered Jewish infants from the high risks of death prevalent in Gibraltar during the latter part of the 19th century, and from the weanling diarrhea triad in particular. These features include higher socioeconomic status, a lower fertility rate, a system of hierarchical welfare, and beneficial attitudes toward health, hygiene, and disease that, interacting together, reduced the risks of infant death.

The relationship between socioeconomic status and infant mortality is well known (Klein 1980) and has been shown to be associated with persistent intrapopulation variation in infant mortality rates (Morris and Heady 1955; Kiple and Kiple 1977). Historical evidence suggests that the Sephardim enjoyed a higher socioeconomic status than other Gibraltarians owing to their almost exclusive participation in lucrative mercantile occupations (Sawchuk 1978). Consequently, members of the Jewish community tended to be relatively advantaged in terms of housing, nutrition, and medical care (Burford-Hancock and Collins 1889; Montegriffò 1978; Sawchuk and Flanagan 1979).

Numerous studies have demonstrated that Jews tend to have lower fertility than the general populations within which they reside (see Della-Pergola 1980). This proved to be the case in Gibraltar. As the crude birth rates in Figure 3 suggest, the fertility rate of the Sephardim was substantially lower than that of the non-Jewish residents of Gibraltar. Furthermore, a previous study of Jewish fertility (Sawchuk 1980) demonstrated that the increased risks of infant mortality associated with multiparity (Wray 1979), early and late pregnancies, and illegitimate births (Lomax 1972) would not be expected in the Sephardic community.

It has been suggested that traditional patterns of culture and certain religious observances may reduce the risks of disease and death in Jewish communities (Fishberg 1911; Solis-Cohen 1946; Jakobovits 1967; Weisenberg 1969; Munter 1977). Jewish tradition, for example, em-

phasizes medical care as a community service (Marcus 1947). In Gibraltar, the Sephardic community had a complex system of community care for the poor and ill (Serfaty 1958) best described as a hierarchical welfare system (see Geertz 1979). A taxation system (*Escamot*) imposed by the community leaders (Hebrew *Syndicks*) and the Chief Rabbi served to collect money from Jewish merchants, traders, and proprietors, proportionate to their means. The threat of excommunication (*Herem*) provided a powerful sanction for the system. Funds were redistributed to the Jewish poor in the form of food, clothing, and other services, through a number of voluntary sodalities. In addition, a Sick Jewish Poor Relief Society, to which every Jew made weekly contributions, operated from 1866 onward (Serfaty 1958).

The mosaic-Talmudic hygienic rituals, which prescribe personal, domestic, and civil sanitation (Solis-Cohen 1946) may enhance the probability of survival of Jewish infants when sanitary conditions are poor. It is the duty of a Jew, moreover, to use every resource to overcome disease (Jakobovitz 1967) and personal health care is a moral obligation (Schleiden 1883; Weisenberg 1969). The alleged promptness with which Jews seek medical attention (McCarthy 1912; Bogen 1931) and their purported willingness to accept new preventive measures and therapy (Fishberg 1911) may also stem from this attitude.

These aspects of the Jewish cultural pattern stand in contrast to what is known for non-Jewish Gibraltarians. Gibraltar's medical officers complained about the lack of an elemental concept of personal or domestic hygiene (MacPherson 1892; Fowler 1912); the lack of appreciation of the dangers associated with common childhood diseases, such as diarrhea and measles (Smales 1922); and the prevalence of folk remedies such as the application of lamb's fat and pigeon entrails to body parts (MacPherson 1892). The situation of the poor in Gibraltar was doubtless comparable to that described for Victorian England, where the cost of medical care, the fear and dis-

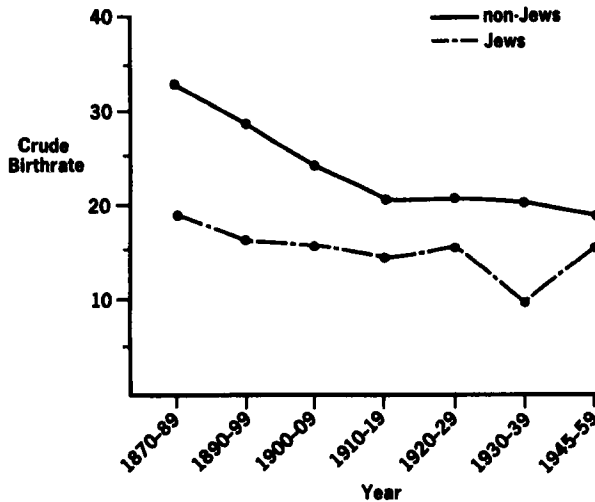


Figure 3

Birth rate per 1,000 living for the Jewish and non-Jewish residents of Gibraltar (based on the census of 1878, 1891, 1901, 1911, 1921, 1931, 1951 respectively).

trust of doctors, the practice of folk medicine, and a fatalistic attitude to infant deaths made the poor unwilling to call in doctors for infant diseases (Wohl 1983:18).

The elaboration of biomedical sanitary-social ideals in the late 19th and early 20th centuries, however, stimulated a dramatic decline in infant mortality in Gibraltar (see Figure 1). Significant improvements in the water, sewage, and food supply, begun in the 1890s, were substantially complete by the 1920s. Although it is difficult to elucidate the effects of specific practices on mortality rates (Condran and Crimmins-Gardner 1978), there is little doubt of the relationship between high infant mortality rates and sewage disposal practices (Dyhouse 1978).

The influence of the child welfare movement and the growing conviction that infant deaths were preventable (Shryock 1979; Dyhouse 1978) led to the establishment of the Child Welfare Centre in Gibraltar in 1918. The primary function of the Centre was to socialize Gibraltar mothers into the ideals and practices of biomedicine (see Smales 1923:41). Increased concern with maternal and child health led to the development of

other specialized institutions, such as the Maternity and Children's Wards in the Colonial Hospital in the 1920s. In addition, the 1900s were marked by the emergence of a number of voluntary sodalities that attempted to improve the lot of the poor and sick in Gibraltar. One of these, the Gibraltar Needlework Guild (established in 1920), specialized in distributing infant clothing to needy, expectant mothers.

In short, institutions and practices that had long existed among the Sephardim by virtue of their religious and ethnic history began to proliferate among the non-Jews in the early 20th century. The net effect of drastically improved public sanitation and community care for the poor and ill and better health and hygiene practices was a reduction in the vulnerability of non-Jewish infants to the weaning diarrhea triad and thus a marked increase in infant survivorship.

Summary

The transformation of the patterns of infant death in Gibraltar coincided with the elaboration of biomedical sanitary-social ideals and practices and, possibly, with the demographic transition to

smaller families. This is reflected in the progressive reduction in infant deaths in both groups over time. The impact of this culture change, however, was greater in the non-Jewish segment of the population and is reflected in the gradual diminution in the Jewish advantage vis-à-vis infant mortality over time. This narrowing of the gap between Jewish and non-Jewish rates fits the general pattern observed in similar European and American comparative studies (Schmelz 1971).

The Jewish advantage in Gibraltar operated at a time when infant mortality rates were high and when ecological factors increased the risks of infant death. In particular, Jewish infants died significantly less frequently from teething, interpreted here as weanling diarrhea, when the ecological conditions in Gibraltar were at their worst (1870-99). Although interpretation of the cause-specific differential from 1900 to 1929 is complicated by the elimination of teething as a disease category, Jewish infants died less frequently from the diarrhea, pneumonia/bronchitis, and nutrition triad that underlies the weanling diarrhea phenomenon. When non-Jewish infant deaths from the weanling diarrhea triad fell dramatically from 1930 to 1959, the Jewish advantage in infant survivorship ceased to be statistically significant.

The Gibraltar findings suggest, therefore, that Jewish communities experience significantly lower IMRs than their non-Jewish neighbors when ecological conditions are poor, fertility rates are high, and when weanling diarrhea is a major cause of infant death. Our results also fall in line with the observation that mortality differences within the same population will narrow as public and private hygiene and the use of health services become universal, and as family limitation methods bring birth rates in line (Schmelz 1971).

The elaboration of biomedical sanitary-social ideals and practices among non-Jews in Gibraltar represents a case of cultural convergence toward a system that historically operated within the Jewish community. Consequently, as the new ethnomedical ideas, practices, and institutions became established among non-

Jewish Gibraltarians, the initially dissimilar epidemiological patterns of infant death were gradually transformed into essentially similar patterns by the 1930s.

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References Cited

- Abramson, J. H., and R. Goffin
1979 Mortality and Its Causes among Moslems, Druze and Christians in Israel. *Israel Journal of Medical Science* 15 (12):965-972.
- Alland, A.
1966 Medical Anthropology and the Study of Biological and Cultural Adaptation. *American Anthropologist* 68:40-51.
- Bogen, E.
1931 Racial Susceptibility to Tuberculosis. *American Review of Respiratory Disease* 24:522-529.
- Bourgeois-Pichat, J.
1951 La Mesure de la Mortalité Infantile I. Principes et Méthodes. *Population* 6:233-249.
- British Medical Journal
1970 Teething Troubles. Volume 2:67-68.
1975 Teething Myths. Volume 4:604.
- Burford-Hancock, H., and R. Collins
1889 Report of the Commissioners Appointed by the Commission of H. E. The Governor, Under the Provisions of the Commissions of Enquiry Ordinance 1888. Gibraltar: Garrison Library Printing Office.
- Cohen, S. A., K. M. Hendricks, and W. A. Walker
1979 Diarrhea of Teething: Dietary Relationships. *Pediatric Research* 13:397.
- Cohen, S. A., and W. A. Walker
1979 The Association between Tooth Eruption and Symptoms. *Pediatric Research* 13:397.
- Condran, G. A., and E. Crimmins-Gardner
1978 Public Health Measures and Mortality in U.S. Cities in the Late Nineteenth Century. *Human Ecology* 6(1):27-54.

- Dansey-Browning, G.
1913 Annual Report on the Public Health of Gibraltar for the Year 1913. Gibraltar: Garrison Library Printing Office.
- Davies, A. M.
1979 Demography, Morbidity and Mortality in Israel: Changes over 30 Years. *Israel Journal of Medical Science* 15(12):959-964.
- Della-Pergola, S.
1980 Patterns of American Jewish Fertility. *Demography* 17(3):261-273.
- Dyhouse, C.
1978 Working-class Mothers and Infant Mortality in England, 1895 to 1914. *Journal of Social History* 12(2):248-267.
- Elkington, H. P.
1901 Annual Report on the Public Health of Gibraltar for the Year 1900. Gibraltar: Garrison Library Printing Office.
- Feinberg, S. E.
1980 The Analysis of Cross-Classified Categorical Data. Cambridge, MA: M.I.T. Press.
- Fishberg, M.
1911 The Jews: A Study of Race and Environment. London: Walter Scott.
- Foster, G. M., and B. G. Anderson
1978 Medical Anthropology. New York: Wiley.
- Fowler, C. E. P.
1912 Annual Report on the Public Health of Gibraltar for the Year 1911. Gibraltar: Garrison Library Press.
- Garruto, R. M.
1981 Disease Patterns in Isolated Groups. In *Biocultural Aspects of Disease*. H. R. Rothschild, ed. Pp. 557-597. New York: Academic Press.
- Geertz, C.
1979 Suq: The Bazaar Economy in Sefrou. In *Meaning and Order in Moroccan Society*, by C. Geertz, H. Geertz, and L. Rosen. Pp. 123-307. London: Cambridge University Press.
- Glasse, R.
1967 Cannibalism in the Kuru Region of New Guinea. *Transactions of the New York Academy of Sciences* 29(2):748-754.
- Gordon, J. E., I. D. Chitkara, and J. J. Wyons
1963 Weanling Diarrhea. *American Journal of Medical Science* 245:345-377.
- Hahn, R. A., and A. Kleinman
1983 Biomedical Practice and Anthropological Theory: Frameworks and Directions. *Annual Review of Anthropology* 12:305-333.
- Hansen, E. deG. R.
1979 "Overlaying" in 19th-Century England: Infant Mortality or Infanticide? *Human Ecology* 7(4):333-352.
- Jakobovits, I.
1967 Jewish Medical Ethics. New York: Boch.
- Jelliffe, D. B., and E. F. P. Jelliffe
1978 Human Milk in the Modern World. Oxford: Oxford University Press.
- Kiple, K. F., and V. H. Kiple
1977 Slave Child Mortality: Some Nutritional Answers to a Perennial Puzzle. *Journal of Social History* 10:284-309.
- Klein, S. D.
1980 Class, Culture, and Health. In *Maxcy-Rosenau Public Health and Preventive Medicine*. J. M. Last, ed. Pp. 1021-1034. New York: Appleton-Century-Crofts.
- Knodel, J., and H. Kintner
1977 The Impact of Breast Feeding Patterns on the Biometric Analysis of Infant Mortality. *Demography* 14:391-409.
- Latham, M. C.
1975 Nutrition and Infection in National Development. *Science* 190:561-565.
- Lieban, R. W.
1977 The Field of Medical Anthropology. In *Culture, Disease and Healing*. D. Landy, ed. Pp. 13-31. New York: Macmillan.
- Lomax, E. R.
1972 Advances in Pediatrics and Infant Care in 19th Century England. Ph.D. dissertation, University of California, Los Angeles.
- MacPherson, W. G.
1892 Annual Report on the Public Health of Gibraltar for the Year 1891. Gibraltar: Garrison Library Printing Office.
- Marcus, J. R.
1947 Communal Sick-Care in the German Ghetto. Cincinnati: Hebrew Union College Press.
- McCarthy, F. P.
1912 The Influence of Race in the Prevalence of Tuberculosis. *New England Journal of Medicine* 166:104-213.
- McKeown, T., R. G. Record, and R. G. Turner
1975 An Interpretation of the Decline in Mortality in England and Wales in the Twentieth Century. *Population Studies* 29:391-422.
- Montegriffo, C.
1978 History of Medicine in Gibraltar. *British Medical Journal* 2:552-555.

- Morris, J. N., and J. A. Heady
1955 Mortality in Relation to Father's Occupation, 1911-1950. *Lancet* 1:554-559.
- Munter, S.
1977 Medicine in Ancient Israel. *In* *Medicine in the Bible and the Talmud*. New York: Yeshiva University Press.
- Neanderland, R.
1952 Teething—A Review. *Journal of Dentistry for Children* 19:127-132.
- Neel, J. V.
1970 Lessons from a "Primitive" People. *Science* 170:815-822.
- Peritz, E., and A. Tamir
1979 Remarks on the Mortality of Ashkenazim, with Data on European Jews Born in Israel. *In* *Genetic Diseases among the Ashkenazi Jews*. R. M. Goodman and A. G. Motulsky, eds. Pp. 415-424. New York: Raven Press.
- Radbill, S. X.
1965 Teething as a Medical Problem. *Clinical Pediatrics* 4(9):556-559.
- Sawchuk, L. A.
1978 Fertility Differentials among the Sephardic Jews of Gibraltar: Implications for Population Structure. Ph.D. dissertation, University of Toronto.
1980 Reproductive Success among the Sephardic Jews of Gibraltar: Evolutionary Implications. *Human Biology* 52:731-752.
- Sawchuk, L. A., and L. E. Flanagan
1979 Infant Mortality among the Jews of Gibraltar, 1869 to 1977. *Canadian Review of Physical Anthropology* 2:63-72.
- Sawchuk, L. A., and D. A. Herring
1984 Respiratory Tuberculosis Mortality among the Sephardic Jews of Gibraltar. *Human Biology* 56(2):291-306.
- Sawchuk, L. A., and L. Waks
1983 Religious Exogamy and Gene Flow among the Jews of Gibraltar, 1870-1969. *Current Anthropology* 24:661-662.
- Schleiden, J. J.
1883 *The Sciences among the Jews: Before and During the Middle Ages*. Baltimore: Binswanger and Company.
- Schmelz, U. O.
1971 Infant and Early Childhood Mortality among the Jews of the Diaspora. Jerusalem: Institute of Contemporary Jewry.
- Serfaty, A. B. M.
1958 *The Jews of Gibraltar under British Rule*. Gibraltar: Garrison Library Printing Works.
- Shryock, R. H.
1979 *The Development of Modern Medicine*. Madison: University of Wisconsin Press.
- Smales, W. C.
1923 *Annual Report on the Public Health of Gibraltar for the Year 1921*. Gibraltar: Garrison Library Printing Office.
- Smith, E.
1889 *A Practical Treatise on Disease in Children*. London: J. and A. Churchill. Pp. 586-593.
- Smith, D. G., and R. S. Guinto
1977 Leprosy and Assortative Mating on Mactan Island, Philippines. *Medical Anthropology* 1(4):75-86.
- Sokal, R. R., and F. J. Rohlf
1969 *Biometry*. San Francisco: Freeman.
- Solis-Cohen, S.
1946 *Judaism and Science*. Philadelphia: S. Solis-Cohen.
- Thestrup, P.
1972 Methodological Problems of a Family Reconstruction Study in a Danish Rural Parish before 1800. *Scandinavian Economic History Review* 20:1-26.
- Weisenberg, D. H.
1969 *The Jewish Way*. North Quincy, MA: Christopher Publishing House.
- Wohl, A. S.
1983 *Endangered Lives: Public Health in Victorian Britain*. Toronto: J. M. Dent and Sons.
- Wray, J. D.
1979 Maternal Nutrition, Breastfeeding and Infant Survival. *In* *Nutrition and Human Reproduction*. W. H. Mosley, ed. Pp. 197-229. London: Plenum Press.

Mechanical Properties of a North American Aboriginal Fishing Line: The Technology of a Natural Product

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Humanity has long exploited the organic world for materials to produce artifacts. While organic materials are readily available, their native properties are rarely well suited to human needs; manipulating these properties is probably humanity's oldest technology. Here I describe the mechanical significance of the