The Washington County Training Center: An Exemplar of Public Health Research in the Field

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Although the Training Center for Public Health Research in Washington County, Maryland, is only in its 29th year, its roots are contemporaneous with the founding of The Johns Hopkins University School of Hygiene and Public Health in 1916. The founders wanted students to have practical exposures to health problems and their control in both urban and rural areas. For urban field experiences, Baltimore City was the logical choice. However, because the city health officer was antagonistic, it was not until 1932, when Dr. Huntington Williams became the city health officer, that the urban connection with the School could be established (1).

The School's link to Washington County was triggered by an obscure event that was to have unforeseen and far-reaching ramifications. This was the organization on March 3, 1911, of the Hagerstown Civic League, established by the leading women of the community "to labor for the civic betterment of Hagerstown and its vicinity" (2). One of its first functions was to raise funds to support a tuberculosis nurse in cooperation with a number of local organizations and the Maryland Association for the Prevention and Relief of Tuberculosis. From the outset, a major deterrent to public acceptance was that a visit from the nurse identified the family as tuberculous. To circumvent that stigma, the service was expanded to include general public health nursing and was placed under the auspices of the newly created Washington County Public Health Association. Even though other areas in Maryland had had tuberculosis nursing services, it seems likely that it was the unusual community support for public health nursing that attracted the School's attention to Washington County.

As a result, the Washington County Health Demonstration was established in 1921, the year of the third graduating class from the School of Hygiene. Its support came from multiple sources, either as money or the allocation of personnel. Major contributors were the Maryland State Department of Health, the US Public Health Service, and the International Health Board of the Rockefeller Foundation. In addition, the Security Cement and Lime Company provided the salary for one field nurse, a unique instance of community support (3).

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ably complete services. Welfare and social services were available from the King's Daughters, a charitable organization, who had an office in the same downtown building. The laboratory services "enabled the medical men of Washington County to obtain very prompt aid in the diagnosis of the acute infectious diseases, far speedier than Washington County enjoyed before, more rapid and more employed, than any other branch or local laboratory in the Counties" (4).

In spite of this resounding success in the provision of services, there were two signal failures. At no point did the County Commissioners or the Hagerstown City Council show any interest in using tax dollars to support these activities. Most important, the lack of official status as a governmental agency handicapped the Demonstration personnel in their efforts to correct environmental hazards.

The field training goal of the Demonstration was also a clear failure. In none of the available reports is there any indication of an interest in academic teaching by the Director of the Demonstration and almost no indication of interest in field training by the faculty of the School. Furthermore, the required visits of students for only 1 week were too short for personal involvement in the activities of the unit and too long to stand around watching someone else work.

The three research projects undertaken in conjunction with the Health Demonstration were all successful even though none was completed in time to influence the decision to discontinue the Demonstration in 1925. Although records of heights and weights of schoolchildren were not put to immediate use, they provided baseline information for studies one and four decades later (5, 6). The pioneering study of employee health in a local cement plant was remarkably complete for its time (7). One of its findings—pertinent today but often forgotten—was that workers who quit work are likely to be the ones whose health is most affected by the work place exposures. Their exclusion from employee surveys is a major contributor to the "healthy worker effect."

By far the most important legacy of the Health Demonstration was the Hagerstown morbidity survey, conducted and reported by Edgar Sydenstricker, an economist who became the US Public Health Service's first public health statistician. "The principal objective of this study was a record of illnesses that were experienced by a population group composed of persons of all ages and both sexes, and in no remarkable respect unusual" (8). Its location was described as "a fairly typical small city in that part of the eastern section of the country which had not been influenced greatly by recent immigration" (8).

The sample of nearly 2,000 households was one of convenience, selected both to be reasonably representative of all segments of Hagerstown's population, except its very small black component, and at the same time to be convenient for the interviewers who visited the sample families every 6–8 weeks during a period of 28 months. This interval between interviews was selected as a reasonable compromise between survey costs and respondent forgetfulness, because Sydenstricker had found that recollection of illnesses fell off rapidly with time (9), another "fact of life" that is often forgotten.

A total of 11 publications, all by Sydenstricker, gave the main results of the morbidity surveys (8, 10–19). Repeated interviews over a period of more than 2 years allowed him to discuss incidence of disease at a time when even prevalence was largely unknown. True to his basic training as an economist, Sydenstricker was particularly interested in the relation of socioeconomic status to health. While overall illness rates were 12 percent higher among the poor than the well-to-do, there were considerable differences by age and by cause of illness. For all causes of illness, there was an unexpected anomaly, namely, that rates among children were higher in the homes rated as comfortable than in poor homes. This was particularly notable for acute infectious diseases. Among older persons, rates were higher among the poor for influenza and gripe, rheumatism, and nervous diseases, and higher among the well-to-do for circulatory disease. That these
findings were not likely to result from differential reporting by rich and poor could be verified because much of the information from the household interviews could be checked against information gathered independently by the Health Demonstration through its clinic services, investigations of notifiable diseases and other home visits, and recording of illness absences from schools and one major industry. This ability to validate morbidity data collected by household interviews had far-reaching consequences: the method was readily accepted; it was applied elsewhere with increasing frequency, usually as a one-time survey to estimate period or point prevalence of illness; and it eventually culminated in one of Sydenstricker's dreams, the National Health Interview Survey.

Research in Washington County virtually ceased with the discontinuation of the Health Demonstration. The exception was that careful systematic recording of heights and weights of schoolchildren continued until 1928. These records, apparently unappreciated and unused during their time, provided a vital link to the next major research project in Washington County, namely, the Hagerstown Health Studies.

The guiding spirit for this next extensive series of studies was Carroll E. Palmer, who had turned down an appointment in Pediatrics at the University of Chicago, at what his wife called a princely salary, to accept an appointment in 1930 as Instructor in Biostatistics at The Johns Hopkins University School of Hygiene at $75.00 a month. A review of Palmer's research suggests that the fundamental lesson from his biostatistics days was the importance of looking at distributions of characteristics in general populations and in their subgroups, and thinking about what similarities or differences in the distributions might mean. This was based on the belief, apparently stressed in biostatistics at that time, that many characteristics in a population, particularly if they had a single cause, were likely to be normally, or at least symmetrically, distributed.

In 1936, Palmer was recruited by Surgeon General Thomas Parran to make research the major role of the Child Hygiene Office of the US Public Health Service. The problems considered to be of major importance were physical growth and development, nutritional deficiencies, dental caries, visual, hearing, and cardiac defects, and tuberculosis. One of the earliest studies concerned the growth of schoolchildren based on the records collected by the Health Demonstration. Although their original purpose had been to establish standards for normal growth, Palmer recognized that they could also be used for investigating factors that influenced growth. As one example, a paper with Lowell Reed (20) demonstrated that the adolescent growth spurt was much more closely related to attained height than to age. A point to be stressed is that the imaginative use of data carefully collected for mundane purposes can indicate unsuspected biologic mechanisms.

An obvious prerequisite for long-term studies is that basic records must be carefully preserved. In 1990, the growth records of more than 13,000 children measured during the period 1933–1945 were linked to subsequent mortality records and to a blood pressure survey conducted in 1974 (F. J. Nieto et al. Childhood weight and growth as predictors of adult mortality. Unpublished manuscript). Overweight in childhood was positively associated with both adult hypertension and long-term mortality. In contrast to results among experimental animals, there was no indication that retardation of growth in early life was associated with longevity.

A second area in which significant contributions were made was dental caries. The investigations were based on the routine school dental examinations done in cooperation with the local health department. To analyze the results adequately, Palmer and Klein developed the DMF index, which is merely the count of decayed, missing, and filled teeth per child, or better, per 100 erupted teeth (21). This seems like an elementary notion now but its use revolutionized dental epidemiology, much as the secondary attack rate did for infectious disease epidemiology.
Nearly 40 years later a sample of adults who had been examined as children was invited to the health department for another dental examination (22, 23). They were asked to bring their families with them. A strong correlation was found between the current caries status of the parents and of their children, but not between the parents’ childhood status and that of their children. Although most of the adult subjects had been exposed to fluoridated water only as adults, there was still an inverse dose-response effect between the percentage of their lives spent in areas with fluoridated water and the frequency of dental caries.

In contrast to their teeth, the lungs of children afflicted with tuberculosis are rarely the site of cavities. Childhood tuberculosis is not often associated with tubercle bacilli in the sputum. For this reason, the pediatric diagnosis of tuberculosis was strongly dependent on a positive reaction to a tuberculin skin test and on the demonstration of pulmonary calcifications by chest radiography. Each of these conditions was considered pathognomonic of tuberculosis until the mid-1930s. At the time, the famous shoe leather epidemiologist, L. L. Lumsden, working in Tennessee and Alabama, shook the tuberculosis world by reporting that many persons with pulmonary calcifications did not react to tuberculin (24). Palmer arranged for a large group of tuberculosis experts to meet in Hagerstown where discrepancies between tuberculin reactions and pulmonary calcifications were also present (25). Groups of schoolchildren and food handlers were scheduled for examinations. Although the experts agreed that the discrepancies were real, no formal report was issued. But there was a major result. Stimulated by a remark by Esmond Long that there might be more than one cause for reactions to the tuberculin test, Carroll Palmer, a tuberculosis neophyte unfettered by the dogmas of the field, came to the conclusion that the only way to explain the discrepancies was the existence of more than one cause for both tuberculin sensitivity and pulmonary calcifications. Much of his subsequent career was spent demonstrating conclusively that nontuberculous mycobacteria were the other cause of tuberculin sensitivity and that *Histoplasma capsulatum* was the other cause of pulmonary calcifications in the United States.

During the 1950s and early 1960s there was little research activity in Washington County. The major study during this period looked at the risk of cardiovascular disease among adult males according to their childhood relative weights as recorded in the school examinations of the 1920s (6). The major finding was that men who acquired their overweight status as adults were at increased risk of hypertensive cardiovascular-renal disease, especially if they had been underweight children; overweight men who had been overweight children were at lower risk. This unique study was possible only because the Division of Public Health Methods, US Public Health Service, had the foresight and resources to retain these early records for nearly 40 years and someone had the imagination to put them to this use.

In 1958, the National Cancer Institute established the Environmental Cancer Research Field Laboratory in Washington County to investigate the apparent concentration of cancer deaths in certain areas of the county and in certain types of houses (26). However, after a 4-year period during which only a third of the county had been investigated, the study was discontinued. Subsequent linkage of the cancer register established by the Research Field Laboratory with a private census of the county conducted by the new Training Center showed that the concentration of cancer deaths paralleled the concentration of older persons.

The Training Center for Public Health Research was officially established on December 12, 1962, at a meeting of the Washington County Commissioners, their Advisory Board of Health, the Maryland Department of Health and Mental Hygiene, and The Johns Hopkins University School of Hygiene and Public Health. In the nearly 30 years of its existence, the Training Center can point to a number of accomplishments. Of the 335 papers related to public health that have been published from Washington
County from 1921 through 1990, 147 were written by Public Health Service employees, almost all prior to 1960, and 160 by persons associated with the Training Center, all by definition coming after 1962.

As the name implies, the Training Center functions as a School facility to provide a base of operations for student research, a source of information about the community, and field supervision of students to the extent desired by their advisers. By the end of 1990, 117 trainees had had some significant research experience with the Training Center. During this period, 25 doctoral theses and 10 master's theses have been based in whole or in part on Washington County data. At the beginning of 1991, seven other students were working with Washington County data for their dissertations. In addition, 334 students, mostly preventive medicine residents, have participated in 1- to 3-day introductions to rural public health.

Training Center data have also contributed to classroom teaching at the School, largely as the basis for laboratory problems in the courses on epidemiologic methods. For example, the data bases for the laboratory section in one course consist of the 1963 private census data linked to deaths during the next 12 years and 1975 census data linked to cancer cases occurring during the next 14 years. Each of these data sets gives students an opportunity to design and analyze a wide variety of studies in a uniquely realistic fashion.

While it is clearly impossible to review all the data bases or the research papers that have come from them, four papers will illustrate major points.

A number of previous studies of bereavement have found an increased risk of mortality among surviving spouses, particularly widowers. Almost all of these studies were cross-sectional or failed to have adequate controls. One of the few large prospective studies of mortality among bereaved and nonbereaved persons used mortality data linked to the 1963 private county census (27). Among persons who became bereaved and a control group of married persons, survival was poorest for widowers in every age group. Essentially no association of bereavement and mortality was observed among women.

This study involved individual follow-up of bereaved persons and controls to be sure that they were still living in the county and, hence, at risk of having their deaths reported as county residents. While the need for such individual follow-up is often cited as a necessary evil of prospective studies, it is not necessarily so. From the 1963 census, a 5 percent sample of households was contacted 8 years later to ascertain their current vital status and residence. The probabilities of remaining in the county were then calculated and adjusted for a variety of pertinent initial characteristics. Applying the resulting multiple regression equation, a probability of living in the county was entered into the census tape for every enumerated adult. To calculate person-years of observation 8 years later, all that is required is to sum probabilities rather than persons. This is an inexpensive way of adjusting an initial population for losses over time. It can easily be extended to other follow-up periods by extrapolation. This unique contribution to follow-up studies warrants much wider application.

This technique was applied to one of the few studies in this country of socioeconomic status and mortality based on individual follow-up (28). There was a slight inverse association of education and mortality from all causes, a somewhat greater inverse association with arteriosclerotic heart disease deaths, and a marked inverse association with rheumatic heart disease. In contrast, well-educated persons were at significantly greater risk of dying from suicide and diabetes.

A major advantage of working in a relatively small community is that population mobility is often minimal. Even when people do move away, some relative or friend in the community can tell how to contact the emigrants. To assess the long-term effects of radium treatment of enlarged adenoids, children who had been treated for hearing loss were contacted 18–35 years later (29). As hypothesized, there was an excess risk of head and neck tumors among those
treated with adenoid irradiation. A surprising finding was a deficit of breast cancer, possibly related to the fact that the pituitary gland was also irradiated along with the adenoids. The pertinent point here, though, is that local resources made it possible to locate 90 percent of the eligible subjects on a very small budget.

A final example is one based on the Washington County serum bank, which now ranks among the largest in the world, with well over 50,000 specimens, together with diet histories, white cells, and toe nail clippings from those who participated in a second collection program in 1989. Dehydroepiandrosterone is a steroid hormone produced in the adrenal glands. Dehydroepiandrosterone and its sulfate are associated in some way with aging and protect against cancer in rodents (30, 31). Dehydroepiandrosterone and its sulfate were found to be associated with protection against bladder cancer in humans (32). Although this study was based on cases and controls and, hence, is a case-control study, the fact that the exposures—namely serum levels of dehydroepiandrosterone—are based on specimens collected in 1974 makes it a prospective study as well. Another point, one that needs much greater emphasis than is usually given, is that only when cases and controls are both drawn from the same population listing can the major assumption of case-control studies be met with any degree of certainty. This assumption is that cases are a representative sample of all cases in a defined population and that controls are a representative sample of all noncases in the same population. Being able to meet this basic assumption in a wide variety of populations is one of the major strengths of Training Center studies.

The future for public health research in Washington County looks increasingly bright. With two major collaborative cardiovascular studies, Atherosclerosis Risk in Communities and Cardiovascular Health Study, having completed their initial rounds of examinations and being well into subsequent rounds, their populations with a wide variety of newly determined characteristics will allow a tremendous number of analyses (33, 34). Already a number of intriguing links between past and present examinations have been identified for study. Still another pioneering study is a community-wide survey of headaches among adolescents and young adults, providing both prevalence data and a baseline for follow-up studies (35).

Perhaps the greatest need in the area of public health research is what Drs. Howell and Frost called for nearly 70 years ago in their critique of the Washington County Health Demonstration, namely, an evaluation of public health services at the local level (36). Ongoing evaluations of local health departments by nonofficial agencies are badly needed and could benefit both the evaluators and the evaluators. Most important, it would give the high level administrators trained in schools of public health important insights into the day-to-day problems of the local units that bring federal and state programs to the people. A training center with its roots in a county health department can be a valuable resource base for the demonstration, evaluation, and improvement of local public health services.

REFERENCES
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