DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Health Resources and
Services Administration
Rockville MD 20857

May 4, 1989

RECEIVED MAY 1 7 1989

Dear Collegue:

Enclosed is a final report on an office of Migrant Health-funded study on parasitic infestation which may assist us in documenting the correlation between safe water and health. This effort was implemented through the NDWP, a technical resource grantee of the Migrant Health Program.

We would welcome your comments on its application and publication potentials. Please write us or call me at (301) 443-1153.

Sincerely yours,

Sonia M. Leon Reig

Sonia M. Leon Reig
Director
Migrant Health Program

Enclosure

Final report on an office of Migrant Health-funded study on parasitic infestation
Dieselski, Stephen
Resource ID#: 2064
Final report on an Office of Migrant Health-funded study on parasitic infestation

NDWP

Rec'd 1/18/89

January 17, 1989

Sonia M. Leon-Reig
Director
Health Resources & Services Administration
Migrant Health Program
Parklawn Building, Room 7A-45
5600 Fishers Lane
Rockville, MD 20857

Dear Sonia:

Enclosed is a copy of the final report on the North Carolina MESA research project. A lot of very important data was gathered in this project that will make it easier to show the correlation between safe water and health.

I am sending a copy to Valerie Wilk as I am sure she will be interested in it, too. Edwin and I met with her last week to discuss the environmental health manual. We plan to include our plans for that in our next proposal to you. Valerie will also incorporate her part into their work plan.
Please let me know if you have any questions.

Sincerely,

Kathy

Kathleen M. Stanley
Deputy Director

cc. Rose Bertanik

call Publish
spoke @ Ed 5/8/89 before sending the ms out
Soren

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1/11/88
Dr. John Richard Seed
Stephen Ciesielski

Kathleen Stanley
Director
National Demonstration Water Project
602 S. King St. Suite 402
Leesburg, VA 22075

Dear Kathleen,

Enclosed is the final report on the research conducted during the summer and fall of 1988. I have tried to make this report as complete as possible. However, since data was still being collected in November, and since there are virtually thousands of records presently being entered on the mainframe computer for analysis, this report of necessity contains general findings. Nevertheless, I believe that the findings in this report are important, reliable, and of extreme significance with regard to migrant health, both on a public health and advocacy level I enclose also a newspaper article regarding my testimony at the NC State Dept. of Labor hearing on field sanitation, and a report in the Migrant Health Newsline of result of parasitology work in 1987. I will forward manuscripts which arise from further

analysis of data.

As we discussed earlier, due to the nature of this research, in which multiple objectives were conducted in a tightly integrated manner at the level of field activities, funds from the NDWP could not always be targeted specifically and directly at certain objectives. However, all of the field and lab work relating to the study of water quality in migrant camps was conducted with NDWP funding. The work funded specifically by the NDWP are printed in boldface type.

There are colleagues of mine at UNC-CH who are now planning additional work with regard to water quality and pesticides. I want to emphasize again, as I have in the report, how drastic and alarming are the results of water quality testing which we obtained.

I wish to thank you once again for your very generous support.

Sincerely,

Stephen Ciesielski

Dr. John Richard Seed

The following report summarizes the research completed under the sponsorship of the National Demonstration Water Project in 1988. Although a significant number of figures, tables, and statistical tests are included in this report, the actual analysis of the entire data base compiled during this time will not be completed until the spring of 1989. At the present time data collected as late as November is just being entered for mainframe computer analysis. Nevertheless, we expect that final analysis will proceed quickly. We will, of course, forward to the NDWP all publications which arise in the future from the research. Because the research involved a number of different objectives, the report is divided into individual sections.

1. Study of Intestinal Parasites

In 1988 cross-sectional study of intestinal parasites was undertaken in 4 counties in eastern North Carolina, in 17 randomly selected migrant camps. A total of 173 subjects participated in stool sampling and received oral questionnaires. Unlike 1987, only foreign born migrants participated in cross-sectional study of parasites in 1988, since it was felt that these workers were at highest risk for infection, as well as having the highest prevalence. Although final results have not yet been tabulated, the prevalence of parasites is in general similar to

found in 1987, as reported in Appendex A. It appears that the composition and demographic variables in the 1988 sample are not dissimilar from those in the 1987 sample. Thus, it will be possible to merge these two groups for greater power in statistical tests at the time of final analysis.

With regard to risk factors for infection with parasites, findings from 1988 are again similar to those from 1987. The only major exception is that a greater number of workers report the availability of field sanitation. Nevertheless, coverage is far from complete, and the absence of field sanitation remains perhaps the most prominent presumptive risk factor for infection with parasites. This is especially true with regard to the high prevalence of hookworm and other helminthic infections found again in 1988.

Although parasitic infections were associated with typical, self-reported symptoms in 1987, in order to more accurately assess the health impact of intestinal parasites in this population hematocrits were performed on a substantial percentage of subjects participating in the parasite study. Preliminary examination of data suggests that hookworm infections are associated with lower hematocrits.

The question of the extent of transmission and risk factors for infection were partially answered in 1987. However, although the high prevalence of parasites among the American born provides a good estimate of the extent of transmission, risk factors are difficult to specify in a cross-sectional study. For this reason longitudinal study was attempted in 1988. In a transient

population follow-up of subjects is obviously difficult. Nevertheless, 84 subjects (approximately 30%) of the 1987 sample were relocated and tested again with parasites. As seen in Table 1, 10% of this group had infections which were not observed in 1987. While a certain amount of testing variability is inherent in stool sampling, this figure indicates that there is a significant incidence of intestinal parasites in this population. The majority of these infections were protozoan. This is understandable both in terms of the easier transmission of these parasites and due to the disproportionately high percentage of children in the incidence sample. Also, since a disproportionately high percentage of Americans (among whom incidence would be expected to be lower than for foreign born workers) occurred in the incidence sample, the 10% incidence may well be an underestimate.

In order to assess risk factors, water quality testing was conducted in 1988. This aspect of research is discussed more fully below. In all camps in which incidence of protozoa were demonstrated the water was positive for total coliforms and sometimes also for fecal coliforms. Latrines, as opposed to flush toilets, were also associated with incidence of protoza. The relatively small number of camps in which incidence was demonstrated will probably limit the statistical signficance of these associations. Nevertheless, we feel that water is implicated in the transmission of intestinal protozoa in migrant camps. As discussed below, the results of water quality testing are among the most significant aspects of this research on a public health level.

Study of Water Quality

In camps in the random sample in 1988, and in camps in which longitudinal study of parasites was conducted, water was tested for presence of bacteria. A grab sample was used to increase recovery and to assess maximum exposure. Several sampling trials were performed in camps. During the initial trial, a single source in each camp was sampled. Two 100 ml membrane filtrations were cultured for total coliform growth. Two 100 ml membrane filtrations were also cultured for fecal coliform growth. In camps with positive findings for total or fecal coliforms, a follow-up sampling was conducted, when possible sampling two sources from the same camp. Additional samples were again cultured for total and fecal coliforms, and also Escherichia coli. In order to maximize recovery, water testing was delayed until October, after t longest possible habitation in camps. While it is expected that this increased recovery, it also meant that some camps were vacated before water sampling was conducted. In all, 26 camps were tested for water quality.

The results are found in Table 2. An alarmingly high level of contamination was found; 46% of camps were positive for total coliforms, 27% positive for fecal coliforms, and 7% for E. coli. Since these three microbiologic tests are of increasing specificity with regard to evidence of fecal contamination, it can be stated with confidence that substantial fecal contamination of water sources in migrant camps exists. While there has been in the past evidence that rural water sources, especially in the South, have in general higher levels of contamination than urban sources,

there were no bacteria found in any of the water samples from the ten control sites. These control sites were either houses, stores or gas stations located nearby sampled migrant camps.

The current EPA regulations for water quality in the US are that no one sample should contain more than one total coliform, and no two successive samples should contain any total coliforms. In all camps with positive findings these standards were violated. In several camps large numbers of coliforms were found; in two cases dilutions were necessary to accurately count bacterial cultures.

Further analysis of variables associated with bacteriologic findings reveals that water in Hispanic camps was more frequently positive bacteriologically. Why this is so is at present unknown. In addition, camps with latrines also had a higher prevalence of contaminated water, a readily explicable finding. As mentioned above, all camps in which incidence of protozoa was demonstrated (four camps) also had water samples containing total and/or fecal coliforms. This suggests that water born transmission of intestinal protozoa is likely to occur in migrant camps. Protozoa are of sufficiently small dimension that percolation through unconsolidated soils may occur. Table 3 contains a breakdown of these variables and the frequency of positive bacteriologic findings.

It is believed that contamination of water occurs through post-source entry of bacteria. In several camps, water from two different taps/faucets originating from the same source was tested. Frequently water from one tap was positive but the other

was negative, suggesting post-source contamination. However, without repeated sampling these conclusions are tentative.

The results of the water quality study have serious implications with regard to current state and federal migrant housing regulations. In North Carolina and other states, at the present time pre-occupancy testing of water is performed. We intend to obtain the results of this testing for North Carolina migrant camps, especially those in which we conducted testing. We believe that the current procedures are completely inadequate, since pre-occupancy testing is performed after camps have been vacant for as long a 8-9 months. This vacancy, and consequent disuse of sanitary facilities, means that evidence of fecal contamination and the concomitant indications of the inadequacy of water and sanitation facilities will be undetected. In addition, the allegedly common practice on the part of farmers of introducing bleach into wells immediatley prior to testing would obviously further compromise the existing procedures. Since GI infections of undetermined origin constitute a considerable percentage of those presenting complaints at migrant clinics, the question of water quality in migrant camps is a serious issue both at a state and federal level.

Study of Tuberculosis

The study of intestinal parasites in 1987 served as a pilot project for a more comprehensive study of infectious disease in 1988. As stated above, a random sample was employed. To the best of our knowledge, this is the first time that a random sample has been utilized in the study of disease in migrant farmworkers.

There were certain imperfections in the random sample used, largely due to the unavoidable limitations of the sampling frame. In any case, the estimates of prevalence and associated variables for tuberculosis, as well as intestinal parasites and other infections discussed below, are thus the most accurate and most signficant data which has yet been collected in this population. This will greatly increase their utility on both a public health level and with regard to advocacy efforts.

Tuberculosis testing was conducted in 33 randomly selected migrant camps in five counties. A total of 564 subjects participated. Since random sampling was employed, the demographics of this sample are representative of the population as a whole, data which is in itself new and of much utility. Non-response was less than 5% for American as well as Haitian subjects. However, the non-response rate was much higher for Hispanics, approximately 20%. However, this does not in reality compromise the research findings to any great extent, since virtually all cases of non-response occurred because of recent PPD testing in conjunction with the Immigration Amnesty Bill. Since treatment and follow-up are required for PPD positive workers applying for Amnesty, these non-responders are effectively removed from the population at risk as well as removing them as potential sources of new cases.

Each subject received 5 tuberculin units and 5 units of Candida albicans administered by the Mantoux method. Candida was employed as a control with regard to the PPD test. Absence of reaction to PPD was not considered as a negative test in the absence of a positive Candida control. Because of the

unexpectedly high number of negative controls, a follow-up antigen trial using tricophyton was adminstered to a substantial number of subjects with initial negative controls. Each subject also received an oral questionnaire (found in Appendix B) designed to elucidate the epidemiology of tuberculosis in this population. Subjects with positive PPD's provided 2-3 sputum samples. Microscopy and culture was performed by the NC TB Control Branch in Raleigh NC. Sputum was induced by means of an ultra-sonic nebulizer. Over three hundred sputum samples were obtained and tested for the presence of M. tuberculosis and atypical mycobacteria. A substantial number of subjects also received X-rays, although difficulties were encountered in achieving adequate coverage.

The results of the tuberculosis study indicate that TB is a serious and widespread health problem of migrant farmworkers. Table 4 provides the percentages of migrants with current or previous active tubercular disease. Current tubercular disease was defined as the presence of any one of the following variables: 1. sputum samples culture positive for M. tuberculosis; 2: radiography consistent with active tubercular disease regardless of sputum results; 3: current treatment for active tuberculosis (INH and rifampin and/or other second line drugs).

Table 4 indicates that tuberculosis is far more common among American than foreign born migrants. The prevalence of 3% among American migrants is a drastically high rate, especially since the prevalence in the US as a whole is .01%. The fact that TB is so much more common among American migrants is striking when the prevalences in foreign born migrants countries of origin is

considered. In Haiti, for example, TB is the leading cause of use of ambulatory health care services.

The prevalence of PPD positivity reinforces the disparities between the different ethnic groups which comprise the migrant population. As seen in Table 5, 66% of American migrants were PPD positive, 78% of Haitian migrants, and 40% of Hispanic migrants. By far the highest percentage of negative controls occurred among Americans, with the result that fewer Americans had confirmed negative PPD's than did Haitians (18% vs. 22%).

Study of the epidemiology of tuberculosis in this population explains these drastic discrepancies. It was found during research in 1988 that a number of groups at greatly elevated risk for infection with TB, such as the homeless, the previously incarcerated, and the alcoholic, are specifically recruited by migrant crew leaders. Table 6 shows that previous incarceration has a strong statistical association with PPD positivity among American migrants. Table 7 shows that previous homelessness also has a strong statistical association with PPD positivity, as does previous residence in a homeless shelter (Table 8). However, previous risk factors do not fully characterize the epidemiology of TB in this population, as increasing years in farmwork are also associated with PPD positivity, although this last association can only be estimated with certainty with final analysis and adjustment for age.

Since the question of the relation of BCG vaccination and PPD positivity is a still at issue, this point was investigated. No association was found between previous BCG vaccination

(confirmed by visual inspection of scar) and PPD positivity, as seen in Table 9.

MOTT's were also frequent in this population. Again, the American population was most at risk, with 14 of the 15 MOTT's occuring in American farmworkers.

The question of a possibly high level of immunosuppression in the American population emerged from the results of Candida and Tricohphyton testing. While in the absence of further and more specific tests conclusions cannot be made regarding anergy, it should be noted that both Candida and Tricophyton are commonly used in order to determine immunocompetence. Again, 16% of American migrants had negative Candida controls, and the majority of these were negative also with Tricophyton. The fact that factors which can result in immunosuppression, such as alcholism, poor diet and HIV infection are far more common in the American population of farmworkers than among other nationalties lends support to the supposition that a significant level of immunosuppression occurs in American migrants. Additional corroboration of this supposition derives from the extremely high prevalence of both M. tuberculosis and atypicals found during this research. At this time we do not know if there is any association between non-response to Candida and Tricophyton and other infectious disease. Once analysis is completed such correlations should be possible.

Study of Imported Tropical Disease

Blood samples were obtained from 138 foreign born migrants in 18 randomly selected camps. During the summer of 1988 thick and thin films were made and examined microscopically for the presence of Plasmodia species. One subject was positive for P. vivax. This individual was also highly symptomatic. This was a relapse, as determined by interviewing the subject.

However, because infective stages of blood stream forms were found in films, the possibility of autochthonous transmission was investigated. A high percentage of Anophiline larvae were obtained from a pond within the flight range of adult Anophilines. Mosquito traps were obtained from the NC State Vector Control Department and placed nearby the dwelling of the infected subject. Twenty percent of mosquitos recovered were competent malaria vectors (A. quadricmaculatus and A. punctipennis). On dissection and microscopy no sporozoites were found in salivary glands and no oocysts found in the guts (assistance with dissection and anatomical examination was provided by the State Vector Control Dept. of NC). Examination of embryos revaled that no blood meals had been taken.

The possiblity of transmission was reduced by the fact that the infected subject left the camp immediately after diagnosis. There were, however, other factors which increased the possibility of transmission, such as the relative abundance of vectors, the age of the subject, the high intensity of infection, and the temperature and humidity at the time of infection.

Given the prevalence of malaria in regions from which

migrants originate, especially the rapidly increasing numbers of Guatemalans on the East Coast, the possiblity of imported cases needs to be considered on a clinical level, and the possibility of transmission merits study on a public health level. Primary care workers should become more familiar with this and other tropical diseases.

Serum from 138 subjects is currently being tested with a new ELISA test for cysticercosis by Dr. John Estrada at Wake Forest University. Later testing with an ELISA for T. cruzi will also be conducted. Since additional serum will remain after completion of these tests, further serologic tests are planned. In early January HIV antibody tests will be conducted. It is hoped that serologic tests for malaria will also be obtained. In addition, since a substantial amount of serum was collected, it should be possible to conduct additional testing.

Conclusion

The research accomplished in 1987 and 1988 constitutes the largest study to date of infectious disease in migrant farmworkers. Through the use of careful scientific methods, such as random sampling, the results obtained will be generalizable to the population as a whole, at least in North Carolina. Thus, the acute deficit in substantive knowledge of the distribution of disease in this population, a situation which has complicated and perhaps reduced federal funding of migrant clinics, will be in some degree supplied. The results of this research have great potential for direct and practical public health interventions.

As evidenced by the newspaper clipping provided in Appendix C, the results of this research can be used to advocate improved occupational conditions for migrants.

The following general conclusions can be stated:

1. The prevalence of imported infections with intestinal parasites, especially hookworm, is sufficiently high for serious concern and intervention on a public health level.

2. The incidence of intestinal parasites, as demonstrated by the high prevalences found in American born migrants and by the incidence rate obtained from longitudinal study, is of sufficient dimension to make public health interventions a necessity.

3. The existence of risk factors for transmission of intestinal parasites, such as lack of field sanitation and lack of water for washing in the fields, is widespread. In order to prevent transmission, basic sanitation and water standards should be improved.

4. The water quality in migrant camps is drastically worse than that afforded to the general population, whether rural or urban. Water born transmission is implicated in protozoal incidence. In addition, transmission of bacterial or viral pathogens may greatly exceed that of protozoa.

5. The prevalence of tuberculosis is dramatically higher among migrants than the general US population, and American born migrants are at far greater risk for infection. Recruiting

practices of crewleaders and institutional features of farmwork, such as crowding and alcoholism, increase transmission and development of disease.

6. Imported tropical diseases, such as malaria, do occur in this population. Given the demographic shift documented this summer, cases of imported tropical diseases are likely to increase, with a resulting increase in possibility of transmission.

Table 1. Incidence of Intestinal Parasites in Farmworkers

	Giardia (#)	E. coli (#)	Trichuris (#)
American	1	2	1
Hispanic	2	2	0
Haitian	0	0	1
Total	3	4	2

(n = 84; incidence rate = 10%)

Table 2. Quality of Water in Migrant Camps and Control Sites

	Migrant Camps (%)	Control Sites (%)
Total Coliforms	46	0
Fecal Coliforms	27	0
Escherichia coli	07	0
	(n = 26)	(n = 10)

Table 3. Water Quality and Associated Aspects of Migrant Camps

	Total Coliforms (%)	Fecal Coliforms (%)	Esch. coli (%)
American Camps (n = 11)	33	16	08
Hispanic Camps (n = 12)	55	36	09
Haitian Camps (n = 3)	66	33	00
Camps w/latrines (n = 6)	83	33	16
Camps w/flush toilets (n = 20)	40	25	05

Table 4. Tuberculosis Among Migrant Farmworkers

(n = 557)

	American (%)	Hispanic (%)	Haitian (%)
Current Tuberculosis (Active)	3.0	0.4	0
Previous Tuberculosis (Active)	8.4	1.3	2.7

(Americans: n = 298)

(Hispanics: n = 223)

(Haitians: n = 36)

Table 5. PPD Positivity among Migrant Farmworkers

(n = 557)

	Americans (%)	Hispanics (%)	Haitians (%)
Positive PPD	66	40	78
Negative PPD	18	48	22
Negative Control	16	12	00

(Americans: n = 298)

(Hispanics: n = 223)

(Haitians: n = 36)

Table 6. Previous Encarceration and Exposure to Tuberculosis among American Migrants (older than 16 years)

	Previous Encarceration		
	yes (number)	no (number)	
Positive PPD	66	85	P value = < .0005
Negative PPD	22	51	(negative controls excluded)
Negative Control	20	20	

(n = 264)

Table 7. Previous Homelessness and Exposure to Tuberculosis (Among American Migrants (older than 16 years)

	Previous Homelessness		
	yes (number)	no (number)	
Positive PPD	59	92	P value = < .0005
Negative PPD	13	60	(negative controls excluded)
Negative Control	21	19	

(n = 264)

Table 8. Previous Residence in Homeless Shelters and Exposure to TB Among American Migrants (older than 16 years)

	Previous Residence		
	yes (number)	no (number)	
Positive PPD	46	106	P value = < .0005
Negative PPD	10	62	(negative controls excluded)
Negative Control	18	22	

(n = 264)

Table 9. BCG Vaccination and PPD Positivity among Migrants from Latin America

	Previous BCG	
	yes (number)	no (number)
Positive PPD	42	51
Negative PPD	49	67
Negative Control	08	11

(n = 228)

MIGRANT HEALTH
clinical supplement
April/May, 1988

Inside:
A Grassroots Model of Health Services for Migrant Students (Page 3)

Preliminary Report:

Intestinal Parasites in Migrant Farmworker Children in North Carolina

By: Robert W. Edwards, School of Public Health, University of Carolina, Chapel Hill, North Carolina

Communicable diseases, including parasitic infections, are very prevalent in the migrant farmworker population. Ortiz (1980) found a variety of parasitic infections in migrant farmworkers in western Massachusetts[1]. This study showed a high prevalence rate (35.5%) of intestinal parasitic infections in the individuals examined. In addition to the high numbers of parasites found in migrant workers, two cases of infections were also found in migrant children born in the U.S., who had never traveled outside the U.S., thus confirming that there is ample opportunity for the spread of parasitic infections in the migrant camps. Similar results have been reported in a study of the parasitic infections of migrant farmworkers from the eastern shore of Maryland[2]. This study reported a 34.2% prevalence of parasitic infection, with one or more intestinal parasites, in the study population of 339 migrant farmworkers. In addition, day-care or head start attendance by children seems to enhance the likelihood of the spread of communicable infections, including parasites, due to increased contact and the lack of good personal hygiene[3]. As a result of these previously documented reports on the intestinal parasitic infections in migrant farmworkers and in children attending day care, an on-going study has been developed to identify and determine the magnitude of parasitic infections in migrant farmworker children and to correlate these infections with diarrhea and gastro-intestinal distress.

Migrant Head Start provides services for approximately 350 children in eastern North Carolina. The primary ethnic groups include Hispanics, American Blacks, and Haitians.

The objectives of the study are to collect stool samples from children attending Migrant Head Start Centers in eastern North Carolina and to administer a questionnaire to either the parent or person providing care for the child. The questionnaire addresses information about the child's place of birth, history of illnesses, especially gastro-intestinal distress and diarrhea, and general living conditions.

The study population consists of children, ages six weeks-five years, attending migrant Head Start Centers and children, from 6-14 years of age, presenting at the Migrant Community Health Center for primary health care. At least one stool sample is collected for examination for the presence of ova and parasites. Stool samples are collected from study participants and immediately preserved by the two-vial transport method recommended by the Centers for Disease Control for the recovery of all diagnostic stages of intestinal parasites. The vial containing 10% Formalin-preserved stool is processed in the laboratory, by the formalin-ethyl acetate sedimentation method for the concentration of helminth eggs and protozoan cysts. These specimens are examined microscopically, using a wet

(continued, page 2)

Preliminary Report:

Intestinal Parasites in Adult Migrant Farmworkers in North Carolina

By: Stephen Ciesielski and John R. Seed, School of Public Health, University of North Carolina, Chapel Hill, North Carolina

There is very limited information on the parasitic diseases of migrant farmworkers and their families in North Carolina. An indication of the severity of the problem can be found in a published report on parasitic infections of migrant farmworkers from the Delmarva Peninsula, Maryland[1]. This report showed that of 339 individuals surveyed, 34.2% were infected with at least one intestinal parasite, and that 17.7% were infected with a pathogenic parasite. The highest prevalence rates were with *Giardia lamblia* (13.3%) and *Trichuris trichiura* (9.7%). However, a significantly high prevalence was also demonstrated for a number of other parasites, such as hookworm. The prevalence observed in migrant farmworkers from the Delmarva Peninsula appeared similar to that observed in children 0 to 5 years of age in day care centers servicing the migrant farmworker community of the Tri-County (Harnett, Sampson, and Johnston) area of North Carolina (results to be reported separately). Based upon the results in Maryland and those in the North Carolina day care centers, it was believed to be of interest to determine the prevalence rates in adults from migrant camps in the same area of North Carolina.

The Tri-County area of North Carolina contains an estimated 30,000 migrant farmworkers living in some 300 different migrant camps. The size, ethnic origin of the inhabitants, and the socio-economic setting vary considerably between the individual camps. The major groups are American Blacks, Mexicans, Haitians, and Central Americans. The study consisted of two parts. The first was to examine one, preferably

(continued, page 5)

mount-Lugol's iodine preparation. The second vial containing the Polyvinyl Alcohol (PVA)-preserved specimen is smeared onto a microscope slide and allowed to air-dry overnight. The specimen is then stained with Wheatley's modified trichrome stain and examined for the presence of protozoan trophozoites and cysts. The health coordinator at the Head Start Center or the Health Care Provider of the Community Health Center is informed of the results of the stool exam so that appropriate therapy can be initiated. In addition, a series of preventive health education programs is provided to the parents at the Parent-Teacher meetings at the Head Start Center and/or in the migrant camps. Inservice workshops are also provided to the staff at both the Head Start Center and the Community Health Center. These programs are developed to address the pathogenecity, transmissibility, prevention, and control of parasitic infections.

RESULTS:

Successful stool collection has been accomplished on 317 individuals. Prevalence of intestinal parasitic infections among individuals who were shown to have only one parasite was 30.9%, while those with concurrent infections of two or more different species was 17.0%, representing a total prevalence of 47.9%. *Giardia lamblia* was the most common parasite found in infected individuals (34.3% prevalence). This finding compares favorably with the fact that *G. lamblia* is the most common parasite diagnosed in the U.S. However, the prevalance of *G. lamblia* in the general U.S. population has been reported at approximately 4.0%.

Increased prevalence rates were directly related to increased age from 0-3 years of age: 19.1%-85.0%, with decreases from 3-5 years of age: 36.4%-33.3%. The highest rate of infection was from the 5-12+ years of age group, with approximately 80% of the individuals examined having one or more parasitic infection. Prevalences of infections among females (n=154) were not significantly different from prevalences among males (n=163).

Prevalence patterns did differ significantly among migrants by ethnic group. Both American Blacks and Caucasians (n=63) were less frequently infected with intestinal parasites than were Haitians (n=30) or Hispanics (n=224). *Giardia lamblia* infections occurred most frequently (42.0%) in Hispanics, while Haitians had the highest prevalence of nematode (Roundworms) (23.3%) and multiple infections (30.0%). The occurrence of cestodes (Tapeworms), the most rare of the infections reported (n=15), and of single infections did not differ significantly.

The distribution of parasitic species was compared among individuals who had a single infection and those with multiple infections. The results indicate that nematode and cestode (Helminth) infections occur more frequently in multiply infected individuals. A similar pattern was seen when parasitic species distribution was compared among individuals with diarrhea (n=157) and without diarrhea (n=160). Nematode and cestode (Helminth) infections also were more frequently observed in symptomatic individuals (n=32) when compared to those without symptoms (n=8).

DISCUSSION:

Intestinal parasite surveys which have sampled migrant farmworker populations have shown a high prevalence of infection within the group at large[1, 2]. Therefore, it is not surprising to see results similar to those reported in this study. The association between increased prevalence of parasitic infection with increased age from six weeks to three years, followed by a decrease in prevalence of infection in the 3-5 year olds is consistent with what might be expected. The increase in the rate of infection might be explained by the fact that as a child grows older, it becomes more mobile and can potentially be more highly exposed to a contaminated environment. In addition, the lack of good personal hygiene contributes to the increase of intestinal parasitic infection prevalence. However, the data shows a decrease in prevalence as the child gets even older, supporting the thesis that as the child learns and practices proper hygiene, the risk of infection is decreased. Children in the age group greater than five years were shown to have a prevalence of approximately 80%. These individuals were all patients who presented at the Community Health Center with symptoms and were included in the table to demonstrate the clinical significance of intestinal parasites in symptomatic individuals.

The significant association between parasitic infection parameters and ethnic group was not unexpected. Dynamics of infectious organisms are strongly influenced by behavior, customs, and culture, all of which can vary a great deal from one ethnic group to another. In addition, recent immigration from areas endemic for infection may further influence ethnic-associated differences in the rates of parasite burden.

Hispanics in the current study showed a higher prevalence of *Giardia lamblia* infections. This result might be explained by the fact that the majority of children studied in the Head Start Center were Hispanic. Black and others have documented the potential high risk for enteric infections by children attending day care facilities. Haitians were shown to have both an increased prevalence of Nematode or Roundworm infections. Haitians were the most recently landed immigrants of the study group, having emmigrated out of a highly endemic environment for both intestinal and tissue dwelling parasitic infections.

Individuals who were multiply infected with one or more parasites were also found to have an increased association with clinical symptoms, i.e., diarrhea or gastrointestinal distress. Individuals infected with either several different species of parasites or with a heavy burden of a single parasite are generally found to have a higher incidence of symptoms than those harboring lower parasite burdens.

Data in this study support the need to maintain a high index of suspicion for parasitic infestation in migrant children, especially those children with anemia, eosinophilia, gastrointestinal symptoms, or vague abdominal complaints. This hypothesis can be further supported by the tendency of infected individuals to remain asymptomatic, with subsequent development of clinical illness, and the increased risk for transmission to other children and adults in the migrant camps and/or the day care centers.

ACKNOWLEDGEMENTS:

The assistance and cooperation of the Shiloh Head Start Center and the Tri-County Community Health Center was instrumental to the success of this study. In addition, I would like to thank Ms. Lucinda R. Tripp and Drs. John R. Seed and Michael R. Riggs for their assistance in the design, delivery and statistical analysis of the project.

REFERENCES:

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Additional tables which accompany the articles on intestinal parasites in adult and child migrant farmworkers in North Carolina area available from the National Migrant Referral Project, 2512 South IH-35, Suite 220, Austin, Texas 78704.

PARASITES IN ADULT MIGRANTS

(continued from front)

two, stool samples from each individual surveyed within a camp. The second phase was for a worker of our field team to administer a questionnaire to each migrant who supplied a stool sample. The questionnaire included variables such as country of origin, time of residence in the United States, socio-economic parameters, health parameters, occupational conditions, etc. The percent participation in the intestinal parasites survey varied by ethnic group — from below 30% for Americans to nearly 100% for Central Americans, and for the questionnaire 80%.

The preliminary data to be presented here will first briefly analyze the prevalence of intestinal parasites in the total population surveyed, and then will discuss the prevalence rates in individual camps and according to the migrants' country of origin.

SUBJECTS AND METHODS:

The study population consisted of migrant farmworkers, primarily adults, living in labor camps in Sampson, Harnett, and Johnston counties, although some children were included. Camps were the sampling unit. Although a convenience sample was used, we included a comprehensive range of parameters which were examined. Our sample was also highly dispersed geographically.

Subjects were recruited by explaining the purposes of the study and the offer of diagnosis and treatment. The guarantee of dispensation within the camps of any necessary pharmaceuticals was essential in obtaining compliance.

We attemped to obtain more than one stool sample from each subject, but this was not accomplished in all cases. Transport kits containing preservative were provided for each subject, who then prepared the sample. Samples were picked up from camps and processed in the parasitology facility on the grounds of the Tri-County Community Health Center in Newton Grove, N.C. Screening for helminthic parasites was accomplished by formalin ethyl-acetate concentration, iodine staining, and microscopic examination. For detection of protozoa, microscopic examination with iodine and Tri-Chrome stain was used. All samples were read by two different individuals trained in identification of parasites. Quantification of helminthic infections is currently being conducted with preserved specimens, in order to determine the intensity of infection and its correlation with other variables.

Subjects were notified of results within three days, and appropriate pharmaceuticals were dispensed in the camps by a Physician's Assistant.

RESULTS:

The study included 265 individuals in some 24 different migrant camps. The prevalence of intestinal parasites was 64.5%, and the prevalence of pathogenic parasites was 42.2%. The highest prevalences were found for hookworm and *Trichuris trichiura* infections. However, the rates for all the pathogenic parasites were above those reported for non-migrant communities. The data clearly demonstrates that the prevalences were not equal for all ethnic groups. The individuals from Central America or Haiti had considerably higher levels of helminthic infections. Both the American and Mexican groups had limited pathogenic parasites. The prevalence rates observed in the Haitian and Central American migrant farmworker populations paralleled those reported from their countries of origin. In fact, in some camps, the prevalence of hookworm infections is higher than that in many areas of the subjects' country of origin.

The prevalences of the pathogenic parasites observed in the individual camps showed large differences. For example, the American Camp 01 had a prevalence of 30% (predominantly *Giardia* infections), whereas individuals from several other camps did not demonstrate any pathogenic intestinal parasites (Table 1). In some cases, only a single stool sample was obtained, therefore the total absence of parasites cannot be stated with absolute certainty. However, the results do indicate a certain difference in the parasite burdens observed in the different camps. The prevalences for the individual camps are also shown according to the predominant ethnic origin of individuals in each camp. It is again obvious that the rates for the Haitian and Central American camps are generally higher than those of the American or Mexican camps. However, it is important to note the considerable variability was also observed in the Haitian camps. Very high prevalences for the potentially serious pathogenic intestinal parasites, such as hookworm, *E. histolytica* were observed.

(continued, page 6)

TABLE 1

PARASITE PREVALENCE IN INDIVIDUAL MIGRANT CAMPS

CAMP NO.	ETHNIC ORIGIN	NO. INDIVIDUAL SUBJECTS	PREVALENCE (%) PATHOGENIC PARASITES
01	American	13	30
02	American	13	0
15	American	19	5
20	American	10	0
22	American	6	0
24	American	8	0
07	Mexican	2	0
08	Mexican	10	60
12	Mexican	22	0
16	Mexican	7	51
17	Mexican	8	25
21	Mexican	6	0
25	Mexican	8	13
06	Haitian	14	50
09	Haitian	9	22
10	Haitian	10	70
14	Haitian	11	36
11	Haitian	8	50
18	Haitian	8	62
19	Haitian	10	50
23	Haitian	11	36
03	Central American	29	67
04	Central American	12	83
13	Central American	11	64

(continued from page 5)

The length of time the migrants have been in the U.S. without returning to their country of origin was asked in the questionnaire given to each participant. The individuals in a number of these camps have remained in the U.S. for many years. The time of residence in the U.S. is also compared with the prevalence of pathogenic parasites in the same camps. The prevalence does not appear to be correlated with the average length of the migrant's stay in the United States. In addition, variables commonly associated with the transmission of those parasitic infections were also surveyed in the questionnaire. The summary of the responses to these questions can be found in Table 2. It becomes obvious from the data that sanitation facilities in the work fields are usually not present, and that defecation in the field commonly occurs. In addition, it is apparent that a high percentage of migrants do not wear shoes while working in the field, and often fail to do so in their camps. It is apparent that the risk for transmission is increased in the migrant community, particularly in reference to hookworm infections.

TABLE 2

FREQUENCY OF SELECTED VARIABLES ASSOCIATED WITH RISK OF TRANSMISSION OF INTESTINAL PARASITES

	American (%)	Mexican (%)	Central American (%)	Haitian (%)
Presence of Field Sanitation Facilities				
always	15	12	12	0
sometimes	2	3	3	2
never	80	84	86	98
Frequency of Defecation in Fields				
always	20	28	6	7
sometimes	60	50	41	53
never	25	22	43	41
Frequency of Working Without Shoes				
always	18	19	24	3
sometimes	35	3	6	12
never	46	78	70	85
Frequency of Going Shoeless in Camps				
always	11	28	25	47
sometimes	44	16	16	35
never	44	56	59	19

DISCUSSION:

The preliminary data presented here are similar to the results of the survey of migrants from the Delmarva Peninsula.[1] (also found in *Migrant Health Newsline Clinical Supplement*, May/June 1986.) The differences are that the prevalence rates observed in the Tri-County area of North Carolina are overall considerably higher for the pathogenic parasites, and specifically for the prevalence of hookworm and *E. histolytica*. This is of considerable public health importance, since the very high prevalence rates could suggest significant clinical disease in this population. Although the survey was not designed to measure overt clinical illness among the infected individuals, their lean body build and their frequent comments that individuals knew of others who were involved in earth-eating would be consistent with the symptoms and behavioral changes associated with serious hookworm infections. We therefore believe it is important for physicians treating migrants to be aware of the potential problem of pathogenic intestinal parasites as the cause of their clinical illnesses, especially among migrants of Haitian and Central American origin. The similarity between the prevalences of intestinal parasites among Haitian and Central American migrant farmworkers with those reported from their country of origin would also suggest that other serious parasitic infections might also be observed among these populations. It is predicted that cases of filariasis, cysticercosis, malaria, and Chagas' disease will be found. It has previously been observed that 6.7% of Haitian migrants surveyed in a Florida study had filariasis[2]. Similarly, a prior study also documented cases of autochthonous malaria in Mexican migrant farmworkers in California[3]. Therefore, physicians should be aware of the possibility that migrant farmworkers have a much greater possibility of having clinical disease due to parasitic infections than individuals from other non-migrant communities. The treatment of migrant farmworkers in North Carolina, Maryland, and elsewhere would be equivalent to working in the field of tropical medicine.

It has clearly been shown that the prevalence rates of parasitic infections depend upon the migrant's country of origin, and the specific camps in which they resided. There was no obvious correlation between the prevalences and the length of residency in the United States. Camps in which the migrant farmworkers live differ in reference to the degree of crowding, their cleanliness, and the facilities for personal hygiene. Occupational conditions in the field indicate a low level of field sanitation.

The public health approach to reducing pathogenic intestinal parasites from the migrant farmworker population would differ considerably if migrants simply brought their parasite burdens with them from their countries of origin versus if the initial parasitic infections were complicated by endemic transmission.

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