Confidence Interval for $P_M - P_F$

Appointment Keeping Behavior: Males vs Females
with $\alpha = 0.05$

$$p_M = x_M/n_M = 947/1,109 = 0.85$$

$$p_F = x_F/n_F = 1,736/2,063 = 0.84$$

$$C\left[\begin{array}{l} p_M - p_F - 1.96\sqrt{\dfrac{p_M(1-p_M)}{n_M} + \dfrac{p_F(1-p_F)}{n_F}} < P_M - P_F \\ < p_M - p_F + 1.96\sqrt{\dfrac{p_M(1-p_M)}{n_M} + \dfrac{p_F(1-p_F)}{n_F}} \end{array}\right] = 0.95$$

$$\sqrt{\frac{p_M(1-p_M)}{n_M} + \frac{p_F(1-p_F)}{n_F}} = \sqrt{\frac{0.85(0.15)}{1,109} + \frac{0.84(0.16)}{2,063}} = \sqrt{0.0000115 + 0.000065} = 0.013$$

$$C[(0.85-0.84) - 1.96(0.013) < P_M - P_F < (0.85-0.84) + 1.96(0.013)] = 0.95$$

$$C[0.01 - 0.025 < P_M - P_F < 0.01 + 0.025] = 0.95$$

$$C[-0.015 < P_M - P_F < 0.035] = 0.95$$

Two Vaccines

In testing two new vacines, for one group 137 of 200 persons became infected. For the second group, 98 of 150 became ill. Test the hypothesis that the two vacines are equally effective.

1. *The hypothesis*: $H_0: P_1 = P_2$ vs $H_1: P_1 \neq P_2$

2. *The assumptions*: Independent random samples

3. *The α-level*: $\alpha = 0.05$

4. *The test statistic*:
$$z = \frac{p_1 - p_2}{\sqrt{\frac{p_1(1-p_1)}{n_1} + \frac{p_2(1-p_2)}{n_2}}}$$

5. *The rejection region*: Reject H_0: $P_1 = P_2$, if z is not between ± 1.96

6. *The result*: $p_1 = \frac{x_1}{n_1} = \frac{137}{200} = 0.685$, $p_2 = \frac{x_2}{n_2} = \frac{98}{150} = 0.653$

$$z = \frac{p_1 - p_2}{\sqrt{\frac{p_1(1-p_1)}{n_1} + \frac{p_2(1-p_2)}{n_2}}}$$

$$z = \frac{0.685 - 0.653}{\sqrt{\frac{0.685(1-0.315)}{200} + \frac{0.653(1-0.347)}{150}}}$$

$$z = \frac{0.032}{\sqrt{0.001079 + 0.001511}} = \frac{0.032}{0.05089}$$

$$z = 0.629$$

7. *The conclusion*: Accept H_0: $P_1 = P_2$ since z is between ± 1.96

Atopy in Children and Parental Social Class

ABSTRACT

Objectives. This analysis was conducted to determine whether atopic disorders were related to social class in a pediatric population of a former socialist country.

Methods. A cross-sectional study of 2471 schoolchildren was carried out in 1992 and 1993 in 3 towns in the former East Germany. Parents completed a standardized questionnaire regarding health events and lifestyle factors. In addition, skin-prick tests were performed and total serum immunoglobulin (IgE) was determined.

Results. Lifetime prevalence rates for atopic diseases and rates of allergic sensitization were highest in children from social class III (in which parents had more than 10 years of formal education) and lowest in social class I (less than 10 years of parental education), while rates in social class II (10 years of parental education) were constant at an intermediate level.

Conclusions. The data confirmed the assumption that in formerly socialist countries social inequalities existed under the socialist system, which were reflected by a social gradient in health outcomes. The findings support the hypothesis that increased access to modern lifestyle could be one reason for the increasing rates of atopic disorders during the last 3 decades. (*Am J Public Health.* 1998;88:1319–1324)

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In industrialized Western countries, atopic diseases and allergic sensitization in both children and adults have been reported to occur more frequently in higher than in lower socioeconomic groups.[1-7]

Little is known about the distribution of health parameters in general and atopic diseases in particular in the different social categories in populations of the formerly communist countries of Eastern Europe. Studies performed shortly after the collapse of the communist system revealed that prevalence rates for atopic diseases and allergic sensitization in children and young adults in Eastern European countries were substantially lower than those observed in Western Europe.[8-13] It has been postulated that factors associated with Western lifestyle may be responsible for the differences in these ethnically similar populations.[9,14-19]

The fact that differences in the prevalence of allergic diseases parallel differences in resource distribution within Western societies and between West and East leads to the speculation that increased access to modern lifestyle might be associated with a rise in allergic disorders. Detecting a similar social gradient for atopy in an Eastern European population would provide additional evidence in favor of this theory.

In the past, East German society was regarded as characterized by a relatively uniform distribution of resources and living conditions. In the German Democratic Republic, as in all former communist countries, income differences between social groups were relatively small. Education and basic health care were equally accessible to all groups in society. Health prevention programs represented an important aspect of the health care system and were implemented by a network of medical facilities in kindergartens, schools, and places of employment. Immunization programs were highly successful and day care facilities employing well-trained personnel were widely accessible.[20] Nevertheless, in spite of a general lifestyle uniformity, subtle social stratification in former socialist countries existed. This study was designed to determine whether the occurrence of atopic disorders in schoolchildren in the former East Germany was related to parental social class.

Subjects and Methods

Study Population

The cross-sectional health survey was conducted in 1992 and 1993 in 3 communities of the state of Sachsen-Anhalt. All eligible schoolchildren in Hettstedt and Zerbst were invited to participate. One third of the schools from each administrative subdistrict of the Bitterfeld area were arbitrarily selected to represent the total regional area of Bitterfeld. All eligible children in these selected schools were included in the study. There were 2932 target subjects; questionnaires were distributed to 2773 children and returned by 2471. Information on social status was obtained for 2402 subjects (81.9%). Participation rates in the different phases of the study and age and sex

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Note. The contents of this paper are solely the responsibility of the authors and do not necessarily represent the official views of the Fogarty International Center, National Institutes of Health.

TABLE 2—Lifetime Prevalence of Atopic Diseases and Characteristic Symptoms as Reported by Parents and Point Prevalence of Physician-Diagnosed Atopic Dermatitis, Allergic Sensitization, and Elevated Total Serum IgE in 6- to Children Aged 6 to 14 Years (n = 2485), by Social Class[1]: Saarbrücken-Jenbach, Germany, 1992–1993

	Social class[2]					
	I		II		III	
	No.	Prevalence, % (95% CI)	No.	Prevalence, % (95% CI)	No.	Prevalence, % (95% CI)
Atopic disease or symptom (questionnaire information)						
Asthma or wheezy bronchitis[3]	191	4.7 (2.2, 8.8)	1179	7.8 (6.3, 9.4)	1091	10.6 (8.8, 12.6)
Wheezing more than once[3]	173	8.7 (4.3, 13.9)	1117	10.9 (9.1, 12.9)	981	20.6 (18.1, 23.3)
Eczema[3]	180	6.7 (3.3, 11.5)	1180	9.8 (8.0, 11.7)	1064	11.8 (9.8, 14.0)
Hay fever[3]	189	8.5 (4.8, 13.4)	1193	14.1 (12.2, 16.2)	1091	16.5 (14.2, 19.0)
Allergic rhinitis[3]	182	1.1 (0.1, 3.9)	1192	4.1 (3.0, 5.4)	1084	5.0 (3.7, 6.6)
Allergic reaction[3]	189	10.6 (6.8, 15.8)	1178	12.8 (11.0, 14.7)	1083	16.8 (14.2, 17.7)
Atopic dermatitis (dermatologist examination)	193	6.8 (3.6, 9.9)	1188	6.8 (5.3, 8.6)	969	9.0 (7.0, 11.4)
Allergic sensitization (skin prick test)						
At least 1 of 12 tested allergens	189	11.0 (7.1, 17.1)	1207	22.8 (20.8, 25.0)	994	33.1 (29.9, 35.5)
Mite allergens only (Der p1 or Der f1)	188	6.0 (3.4, 9.9)	1207	7.7 (6.1, 9.5)	994	8.3 (6.8, 10.2)
Pure allergens only (penicillin, albumin)	188	0.0 (0.0, 1.9)	1207	0.9 (0.4, 1.7)	994	1.5 (1.0, 2.4)
Pollen (total grasses, trees, nettle, plantain, mugwort)	188	7.3 (3.8, 12.4)	1207	14.3 (12.5, 16.3)	994	19.5 (17.2, 19.9)
Cat epithelium	188	6.9 (3.6, 9.9)	1207	9.1 (7.6, 11.0)	994	12.7 (10.8, 14.9)
At least 2 of 12 tested allergens	188	8.5 (4.7, 13.8)	1207	12.9 (11.3, 15.0)	994	19.2 (16.9, 19.7)
Total serum IgE > 100 IU/mL[4]	191	27.8 (20.8, 36.7)	994	19.9 (17.2, 22.2)	988	19.2 (16.8, 20.5)

Note. CI = confidence interval.
[1]The social level of a family was defined by the highest school grade completed by either the mother or the father of the study subject. Families with parental education of less than 10 grades were termed as belonging to social class I, 10 grades, class II, more than 10 grades, class III.
[2]Physician-diagnosed diseases as reported by parents.
[3]Reported by parents.
[4]The value represents the 80th percentile of the entire population.

exposure. The effects of these potentially confounding variables were assessed in bivariate models that included each covariate separately. Additionally, covariates reaching significance levels of .5 or less in the bivariate analyses were selected for the final multivariate model.

Results

Lifetime prevalence rates for most of the major diseases and characteristic symptoms reported by the parents were highest in children from families with the highest level of parental education (social class III) and lowest in children from families with the lowest level of parental education (social class I). In children from social class II, prevalence rates were consistently at an intermediate level (Table 2).

In the physical examination, atopic dermatitis (previously diagnosed in 2.0% of the children classified as belonging to social class III and in 3.3% of the children in social class II, while none of the 193 examined children in social class I presented signs of eczematous dermatitis. Other health parameters assessed at the physical examination did not reveal significant differences between the social categories. Height, weight, and size of the tonsils were comparable in all 3 groups (data not shown).

Allergic sensitization, defined as a positive response of 3 mm diameter or at least 1 of the 12 tested allergens, was found in 29.6% of the children. The allergic sensitization rates were 22.1%, 26.6%, and 11.8% in the children from social classes III, II, and I, respectively. Allergic sensitization against allergen groups or individual allergens as well as skin reactions to 2 or more allergens showed a similar social gradient (Table 2).

To assess the influence of total serum IgE on the relationship between social class and allergic sensitization, the subjects were stratified into a group with IgE levels above or equal to 100 IU/mL (80th percentile of the entire population) and a group whose IgE levels were below this cutoff point. Although children with high total serum IgE levels presented higher rates of allergic sensitization than children in the low IgE group, the effect of social class on allergic sensitization was evident in both strata (Figure 1).

The distribution of health-relevant factors and lifestyle characteristics among subjects in the 3 social classes is presented in Table 3. These factors were grouped to characterize living conditions that may explain the observed differences in health outcomes between the social classes.

The influence of potentially confounding covariates on the association between allergic sensitization (dependent variable) and social class (explanatory independent variable) and the existence of interaction were analyzed for 1959 study subjects with complete data for the relevant variables. Children in social classes II and III were compared with participants in social class I, which served as the reference group.

The unadjusted odds ratio for allergic sensitization comparing social class III with class I was 2.1, while the odds ratio comparing class II with class I was 2.0 (Table 4). Adjustment for individual covariates did not substantially influence the association between allergic sensitization and social class. Bivariate models containing covariates reaching a significance level of .5 are presented in Table 4. Interaction, assessed by including into each of the bivariate models mentioned above the interaction variable between social class and the covariate under scrutiny, was not present in any of the tested models. The final multivariate model included all variables selected a priori on theoretical grounds (sex, parental atopy, season when skin-prick test was performed, smoking exposure, and total serum IgE) and 2 other variables, study region and number of tested testing, reached a significance level of .05 or less and met the criteria required for inclusion in the final multivariate model.

Total serum IgE (converted to the natural logarithm and treated as a continuous variable) had a considerable influence on the association between social class and allergic sensitization. Inclusion of the IgE variable in

TABLE 2—Lifetime Prevalence of Atopic Diseases and Characteristic Symptoms as Reported by Parents and Point Prevalence of Physician-Diagnosed Atopic Dermatitis, Allergic Sensitization, and Elevated Total Serum IgE in Children Aged 5 to 14 Years (n = 2402), by Social Class: Sachsen-Anhalt, Germany, 1992–1993

	Social class[a]					
	I		II		III	
	No.	Prevalence, % (95% CI)	No.	Prevalence, % (95% CI)	No.	Prevalence, % (95% CI)
Atopic disease or symptom (questionnaire information)						
Asthma or wheezy bronchitis[b]	191	4.7 (2.2, 8.8)	1173	7.8 (6.3, 9.4)	1021	10.8 (8.9, 12.8)
Wheezing (more than once)[c]	173	8.7 (4.9, 13.9)	1117	20.9 (18.5, 23.4)	961	22.8 (20.4, 25.6)
Eczema[b]	190	4.2 (1.8, 8.1)	1180	9.6 (8.0, 11.4)	1024	11.8 (9.9, 14.0)
Eczematous rashes[c]	189	8.5 (4.9, 13.4)	1170	14.1 (12.2, 16.2)	1021	16.5 (14.2, 18.9)
Allergic rhinitis[b]	190	1.1 (0.1, 3.8)	1180	4.1 (3.0, 5.4)	1024	5.0 (3.7, 6.5)
Allergic reaction[b]	190	10.5 (6.5, 15.8)	1170	12.6 (10.8, 14.7)	1023	15.3 (13.2, 17.7)
Atopic dermatitis (dermatologic examination)	163	0.0 (0.0, 2.2)	1053	3.3 (2.3, 4.6)	909	2.0 (1.2, 3.1)
Allergic sensitization (skin-prick test)						
At least 1 of 12 tested allergens	165	11.5 (7.1, 17.4)	1057	20.6 (18.2, 23.2)	904	22.1 (19.5, 25.0)
Mite allergens only (der pt or der fl)	165	3.0 (1.0, 6.9)	1057	7.7 (6.1, 9.4)	904	8.3 (6.6, 10.3)
Fungi allergens only (aspergillus, alternaria)	165	5.5 (2.5, 10.1)	1057	5.2 (3.9, 6.7)	904	7.5 (5.9, 9.4)
Pollen (local grasses, hazel, birch, plantain, mugwort)	165	7.3 (3.8, 12.4)	1057	14.3 (12.2, 16.5)	904	15.5 (13.2, 18.0)
Cat epithelium	165	0.0 (0.0, 2.2)	1057	3.1 (2.2, 4.4)	904	3.7 (2.5, 5.1)
At least 2 of 12 tested allergens	165	8.5 (4.7, 13.8)	1057	12.9 (10.9, 15.0)	904	15.2 (12.9, 17.7)
Total serum IgE ≥ 140 IU/mL[d]	151	27.8 (20.8, 35.7)	984	19.6 (17.2, 22.2)	859	19.2 (16.6, 22.0)

Note. CI = confidence interval.

[a]The social level of a family was defined by the highest school grade completed by either the mother or the father of the study subject. Families with parental education of less than 10 grades were defined as belonging to social class I; 10 grades, class II; more than 10 grades, class III.

[b]Physician-diagnosed diseases as reported by parents.

[c]Perceived by parents.

[d]This value represented the 80th percentile of the entire population.

Social Class I vs Social Class II, Asthma or Wheezy bronchitis

$n_I = 191$ $\quad$ $n_{II} = 1,173$

$p_I = 0.047$ $\quad$ $p_{II} = 0.078$

1. *The hypothesis*: $H_0: P_I = P_{II}$ *vs* $H_1: P_I \neq P_{II}$

2. *The assumptions*: Independent Random Samples
Binomial Data

3. *The α-level* : $\alpha = 0.05$

4. *The test statistic*: $$z = \frac{p_I - p_{II}}{\sqrt{\frac{p_I(1-p_I)}{n_I} + \frac{p_{II}(1-p_{II})}{n_{II}}}}$$

5. *The rejection region*: Reject $H_0: P_I = P_{II}$ if z is not between ± 1.96

6. *The result*:

$$z = \frac{0.047 - 0.078}{\sqrt{\frac{0.047(0.953)}{191} + \frac{0.078(0.922)}{1{,}173}}}$$

$$z = \frac{-0.031}{\sqrt{0.0002 + 0.0001}}$$

$$z = \frac{-0.031}{0.0172}$$

$$z = -1.80$$

7. *The conclusion*: Accept H_0: $P_I = P_{II}$ since z is between

$$\pm 1.96$$

Confidence Interval

We have :

$n_I = 191$ $\quad$ $n_{II} = 1{,}173$

$p_I = 0.047$ $\quad$ $p_{II} = 0.078$

$$C\left[\begin{array}{l} p_I - p_{II} - 1.96\sqrt{\dfrac{p_I(1-p_I)}{n_I} + \dfrac{p_{II}(1-p_{II})}{n_{II}}} < P_I - P_{II} \\ < p_I - p_{II} + 1.96\sqrt{\dfrac{p_I(1-p_I)}{n_I} + \dfrac{p_{II}(1-p_{II})}{n_{II}}} \end{array}\right] = 0.95$$

$$C\left[\begin{array}{l} 0.047 - 0.078 - 1.96\sqrt{\dfrac{0.047(0.953)}{191} + \dfrac{0.078(0.922)}{1{,}173}} < P_I - P_{II} \\ < 0.047 - 0.078 + 1.96\sqrt{\dfrac{0.047(0.953)}{191} + \dfrac{0.078(0.922)}{1{,}173}} \end{array}\right] = 0.95$$

$$C\left[-0.031 - 1.96\sqrt{0.0002 + 0.0001} < P_I - P_{II} < -0.031 + 1.96\sqrt{0.0002 + 0.0001}\right] = 0.95$$

$$C\left[-0.031 - 1.96(0.0162) < P_I - P_{II} < -0.031 + 1.96(0.0162)\right] = 0.95$$

$$C\left[-0.0628 < P_I - P_{II} < 0.0008\right] = 0.95$$

Module 23: Proportions: Confidence Intervals and Hypothesis Tests, Two Samples

This module exams confidence intervals and hypothesis test for two independent random samples for proportions.

Proportions for two independent random samples

P_1 = Parameter for population one
P_2 = Parameter for population two

x_1 = Number in sample one with the characteristic
x_2 = Number in sample two with the characteristic

n_1 = Total number in sample one
n_2 = Total number in sample two

$p_1 = x_1 / n_1$, estimate for sample one
$p_2 = x_2 / n_2$, estimate for sample two

For proportions from two samples

$$H_0: P_1 = P_2 \quad \text{vs} \quad H_1: P_1 \neq P_2$$

Where: $p_2 = x_2/n_2,\ p_1 = x_1/n_1$

The test is based on:

$$z = \frac{p_1 - p_2}{\sqrt{\frac{p_1(1-p_1)}{n_1} + \frac{p_2(1-p_2)}{n_2}}}$$

Appointment-Keeping Behavior Re-Evaluated

PHILIP HERTZ, M.Ed., MSPH, AND PAULA L. STAMPS, MS, PhD

Abstract: Many of the traditional approaches to the problem of appointment-keeping behavior have ignored the organizational factors that may be implicated in differentially high broken appointment rates leading to an implicit assumption that low-income and ethnic minority patients will be more likely to break appointments. A case study at a Model Cities Health Center which maintains a kept appointment rate of 85 per cent examined the relationship of broken appointments to age, sex, ethnic background, and payment mechanisms. The results support alternative explanations for differentially high broken appointments centering on the role of the institution in reinforcing appointment-keeping behavior. (Am. J. Public Health 67:1033–1036, 1977)

Broken appointment rates in ambulatory care facilities range from 16 per cent to 44 per cent. It is important to decrease the broken appointment rate as much as possible in order to provide for the best utilization of the direct care staff members. Explanations of broken appointment rates have concentrated primarily upon factors related to the patients, with emphasis placed upon demographic characteristics, such as socioeconomic status, race, age, sex, and educational levels, with other factors such as attitudes toward health care and personality factors also noted. Occasionally, additional factors have also been investigated, including the effect of weather and distance, and variables associated with the organization itself such as the appointment system, staffing patterns, and information flow in the organization. Most studies have concluded with acceptance of a primary myth which is that low-income patients do not keep appointments as well as people in middle class socioeconomic groups. This has been consistently reported by several investigators over the last ten years.[1–7] The conclusion of the relationship between low income and high broken appointments has been proposed for ambulatory care in fee-for-service settings,[1] psychiatric care,[2] and ambulatory care in a pre-paid setting.[3] The magnitude of the differences vary, but in one of the better-designed studies, Goodrich contrasted appointment-keeping rates of a pre-paid group and an OEO* Comprehensive Neighborhood Health Care Program that was part of the same medical system. The broken appointment rate for the pre-paid health plan sample was 8 per cent and for the OEO health plan sample 25 per cent.[3]

Confounding variables with low social class include age, ethnic identification, and educational levels. In general, the conclusion of these studies is that the older the patients the more likely they are to keep an appointment,[2, 5] and that members of ethnic minorities, especially Blacks and Spanish-speaking are more likely to break appointments.[1, 4, 5, 7] Patients with lower educational levels are generally concluded to be poorer keepers of appointments,[2] although Adler's study did not confirm this relationship for psychiatric patients.[2] Social disorganization of urban families, especially lower-income families, has also been related to poor appointment keeping behavior.[1]

All of these studies have in common the emphasis upon the failure of the patient to keep an appointment, without analyzing the organizational factors which might be responsible for reinforcing poor appointment-keeping behavior. In those studies where efforts were made to increase the kept appointment rate, some interesting observations have been made with respect to the role of the health facility in broken appointments. Three major factors can be identified as being related to appointment-keeping behavior: physician continuity, communication systems, and type of appointment system. Becker found that physician continuity, i.e., seeing the same physician each time, was positively correlated to appointment-keeping among a group of low-income, mostly Black patients.[1] Increased efforts at communication, including various reminders for missed appointments, also seems to be effective in reducing the broken appointment

*Office of Economic Opportunity.

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patients to see specific requested physicians has been used for some time. Postcard reminders are mailed five days prior to the appointment. In some cases, when the staff deems it necessary, home visits are made to those who break their appointments. Home visits are utilized as many of the patients do not have telephones.

Methodology and Data Collection

Data were collected for the adult medical clinics for a 12-month period of time between April 1, 1974 and March 31, 1975, on number of appointments kept and broken, sex, age, ethnic group, and payment mechanism. Chi-square was utilized at a significance level of .5 per cent to test for the existence of relationships between these variables.

The monthly data for each variable were analyzed. Additionally, a chi-square test on the combined 12 months was calculated. There were a total of 3,172 visits recorded to the adult medical clinic during this time period.

Results

The overall kept appointment rate in the adult medical clinics during the study period was 85 per cent.

Out of the 3,172 adult patient visits, 34 per cent were male and 66 per cent were female. As can be seen from Table 1, there were no significant differences in appointment-keeping behavior between males and females.

The age distribution of the population was broken into two categories using age 44 as the cut-off point. As with other studies,[5, 6, 7] the data in Table 1 reveal a tendency for older patients to keep appointments better than younger patients. It should be added that the differences with respect to age are significant for only three months (June, October, and November), but these differences are large enough to contribute to a statistical difference over the entire 12-month period of time.

The majority of the clinic's adult patients are Puerto Rican (69 per cent), with 27 per cent of the patients classified as White and 4 per cent classified as Black. Table 1 also demonstrates that there is a statistical relationship between ethnic group membership and appointment-keeping behavior, with Puerto Ricans having a higher broken appointment rate than either the Whites or Blacks. When these data are analyzed by months, May, June, August, November, February, and March show significant differences. During the months of June and August, neither the appointments secretary nor a bilingual health assistant were present at the Health Center. Both of these persons play key roles in scheduling Spanish-speaking patients. In November, February, and March the adult clinics were changed from their regular night to other evenings and some afternoons in order to accommodate some of the schedules of the physicians. These changes were not adequately conveyed to the non-English speaking patients. The 18.5 per cent broken appointment rate among this group as compared to the 8.5 per cent broken appointment rate among Whites and the 7 per cent broken appointment rate among Blacks appears to be closely associated with these two events. The clinic's failure to fully communicate with the non-English speaking patient population, the erratic staffing of medical clinics, and the changes in the clinic schedule may well have contributed to the higher rates of broken appointments for the Spanish-speaking population. As can be seen from Table 1, these factors did not affect the English-speaking Black and White populations.

Sixty-five per cent of the Health Center's patient population is on Medicaid. As can be seen from Table 1, there is no relationship between Medicaid status and appointment-keeping behavior.

In order to further clarify the relationship of ethnic status and payment mechanism, the three ethnic groups were classified by their payment mechanism. Table 2 shows that there is an association between ethnic group and kept appointments, but this is stronger among those not on Medicaid. This group possesses the same characteristics as the total clinic sample, and thus reflects the same organizational problems that have been previously cited with respect to language problems.

TABLE 1—Distribution of Percentage of Kept and Broken Appointments According to Selected Patient Characteristics

Patient Characteristic	N	% Kept (N = 2,693)	% Not Kept (N = 480)
Sex*			
Male	1,109	85.39	14.61
Female	2,063	84.15	15.85
Age*			
< 45	2,683	82.83	17.17
45+	489	90.37	9.63
Ethnicity*			
Puerto Rican	2,206	81.46	18.54
White	857	91.52	8.48
Black	139	93.03	6.98
Payment Mechanism*			
Medicaid	2,229	83.40	16.60
Non-Medicaid	943	87.38	12.62
TOTAL	3,172	84.88	15.12

* χ^2 = 4.04, df = 1, p < .05
** χ^2 = 14.22, df = 1, p < .005
*** χ^2 = 53.04, df = 2, p < .005
**** χ^2 = 8.05, df = 1, p < .05

to see not significant for only three months (June, October, and November), but these differences are large enough to contribute to a statistical difference over the entire 12-month period of time.

The majority of the clinic's adult patients are Puerto Rican (69 per cent), with 27 per cent of the patients classified as White and 4 per cent classified as Black. Table 1 also demonstrates that there is a statistical relationship between ethnic group membership and appointment-keeping behavior, with Puerto Ricans having a higher broken appointment rate than either the Whites or Blacks. When these data are analyzed by months, May, June, August, November, February, and March show significant differences. During the months of June and August, neither the appointments secretary nor a bilingual health assistant were present at the Health Center. Both of these persons play key roles in scheduling Spanish-speaking patients. In November, February, and March the adult clinics were changed from their regular night to other evenings and some afternoons in order to accommodate some of the schedules of the physicians. These changes were not adequately conveyed to the non-English speaking patients. The 18.5 per cent broken appointment rate among this group as compared to the 8.5 per cent broken appointment rate among Whites and the 7 per cent broken appointment rate among Blacks appears to be closely associated with these two events. The clinic's failure to fully communicate with the non-English speaking patient population, the erratic staffing of medical clinics, and the changes in the clinic schedule may well have contributed to the higher rates of broken appointments for the Spanish-speaking population. As can be seen from Table 1, these factors did not affect the English-speaking Black and White populations.

Sixty-five per cent of the Health Center's patient population is on Medicaid. As can be seen from Table 1, there is no relationship between Medicaid status and appointment-keeping behavior.

In order to further clarify the relationship of ethnic status and payment mechanism, the three ethnic groups were classified by their payment mechanism. Table 2 shows that there is an association between ethnic group and kept appointments, but this is stronger among those not on Medicaid. This group possesses the same characteristics as the total clinic sample, and thus reflects the same organizational problems that have been previously cited with respect to language problems.

Summary and Conclusions

The data presented suggest that the difference in the kept appointment rates of different ethnic groups does not reflect a true ethnic difference in health behavior. For the months when there was no significant difference in appointment-keeping behavior between the White and Puerto Rican populations, the appointment staff was present, and there were no changes in clinic days or medical staff. During five of the six months when such differences occurred, it was because of the absence of the bilingual appointment staff, the changes made in clinic days, and the physician

TABLE 1—Distribution of Percentage of Kept and Broken Appointments According to Selected Patient Characteristics

Patient Characteristic	N	% Kept (N = 2,683)	% Not Kept (N = 489)
Sex[1]			
Male	1,109	85.39	14.61
Female	2,063	84.15	15.88
Age[2]			
< 45	2,683	83.00	17.00
45+	489	90.37	9.63
Ethnicity[3]			
Puerto Rican	2,206	81.46	18.54
White	837	91.52	8.48
Black	129	93.02	6.98
Payment Mechanism[4]			
Welfare	2,229	83.40	16.60
Non-Welfare	943	87.38	12.62
TOTAL	3,172	84.58	15.42

[1] $X^2 = 8.54$; df = 1; $p > .05$
[2] $X^2 = 24.22$; df = 1; $p < .05$
[3] $X^2 = 53.94$; df = 2; $p < .05$
[4] $X^2 = 8.05$; df = 1; $p > .05$

Proportions for Two Independent samples

1. *The hypothesis*: H_0: $P_M = P_F$ vs H_1: $P_M \neq P_F$

2. *The assumptions*: Independent random samples

3. *The α-level*: $\alpha = 0.05$

4. *The test statistic*:

$$z = \frac{p_M - p_F}{\sqrt{\frac{p_M(1-p_M)}{n_M} + \frac{p_F(1-p_F)}{n_F}}}$$

5. *The rejection region*: Reject if z not between ±1.96

6. *The test result:* $p_M = x_M/n_M = 947/1{,}109 = 0.8539 = 0.85$

$p_F = x_F/n_F = 1{,}736/2{,}063 = 0.8415 = 0.84$

$$z = \frac{0.85 - 0.84}{\sqrt{\frac{0.85(1-0.85)}{1{,}109} + \frac{0.84(1-0.84)}{2{,}063}}}$$

$$z = \frac{0.01}{\sqrt{\frac{0.85(0.15)}{1{,}109} + \frac{0.84(0.16)}{2{,}063}}}$$

$$z = \frac{0.01}{\sqrt{0.000115 + 0.000065}}$$

$$z = \frac{0.01}{\sqrt{0.000180}}$$

$$z = \frac{0.01}{0.013422}$$

$$z = 0.745$$

7. *The conclusion:* Accept $H_0 : P_M = P_F$ since z is between ±1.96