Confidence Interval for $P_M - P_F$

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

\[
p_M = \frac{x_M}{n_M} = \frac{947}{1,109} = 0.85
\]

\[
p_F = \frac{x_F}{n_F} = \frac{1,736}{2,063} = 0.84
\]
\[ C \left[ \frac{p_M - p_F - 1.96}{n_M} \sqrt{\frac{p_M(1-p_M)}{n_M} + \frac{p_F(1-p_F)}{n_F}} \right] < p_M - p_F < p_M - p_F + 1.96 \sqrt{\frac{p_M(1-p_M)}{n_M} + \frac{p_F(1-p_F)}{n_F}} \right] = 0.95 \]

\[ \frac{p_M(1-p_M) + p_F(1-p_F)}{n_M + n_F} = \sqrt{\frac{0.85(0.15) + 0.84(0.16)}{1.109 + 2.063}} = \sqrt{0.000015 + 0.000085} = 0.013 \]

\[ C[(0.85 - 0.84) - 1.96(0.013)] < p_M - p_F < (0.85 - 0.84) + 1.96(0.013)] = 0.95 \]

\[ C[0.01 - 0.025 < p_M - p_F < 0.01 + 0.025] = 0.95 \]

\[ C[-0.015 < p_M - p_F < 0.035] = 0.95 \]
Two Vaccines

In testing two new vaccines, for one group 137 of 200 persons became infected. For the second group, 98 of 150 became ill. Test the hypothesis that the two vaccines 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 \( \alpha \)-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 $\pm 1.96$

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

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

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

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

   $z = 0.629$

7. The conclusion: Accept $H_0: P_1 = P_2$ since $z$ is between $\pm 1.96$
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 2,471 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 IgE antibodies (sIgE) were determined.

Results. Lifetime prevalence rates for allergic diseases and rates of atopic sensitization were highest in children from social class III (6) in which parents had more than 15 years of formal education and lowest in social class I (less than 16 years of parental education), while rates in social class II (10 years of parental education) were somewhat in an intermediate level.

Conclusions. The data confirmed the assumption that in former socialist countries socio-economic conditions and the socialist system, which were influenced by a social gradient in health outcomes. The findings suggest the hypothesis that increased access to modern medicine could be one reason for the increasing rate of atopic disorders during the last 3 decades. (Am J Public Health. 1998;88:1319-1325).

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 3 schools were invited to participate. One third of the schools of each administrative subdistrict of the studied areas were randomly selected to represent the total regional area of the study. All eligible children in 3 selected schools were invited to include in the study. There were 2922 target subjects, questionnaires were distributed to 2779 children and returned by 2476. Information on social status was obtained for 2402 subjects (89.1%). Participation rates in the different phases of the study and age and sex.

September 1998, Vol. 88, No. 9
TABLE 2—Lifetime Prevalence of Allergic Diseases and Characteristic Symptoms as Reported by Parents and Personal Prevalence at Physician-Diagnosed Atopic Dermatitis, Allergic Sensitization, and Elevated Total Serum IgE in Children Aged 5 to 14 Years (n = 2408), by Social Class: Saarland-Annaberg, Germany, 1990-1991

<table>
<thead>
<tr>
<th>Social class</th>
<th>Prevalence, %</th>
<th>Prevalence, %</th>
<th>Prevalence, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(95% CI)</td>
<td>(95% CI)</td>
<td>(95% CI)</td>
</tr>
<tr>
<td>Affected CONV</td>
<td>145</td>
<td>4.5 (3.3-5.7)</td>
<td>1173</td>
</tr>
<tr>
<td>Allergic CONV</td>
<td>173</td>
<td>6.7 (4.5-9.3)</td>
<td>1167</td>
</tr>
<tr>
<td>Bronchial asthma</td>
<td>109</td>
<td>4.0 (2.5-5.6)</td>
<td>1167</td>
</tr>
<tr>
<td>Allergic rhinitis</td>
<td>166</td>
<td>6.8 (4.6-9.4)</td>
<td>1167</td>
</tr>
<tr>
<td>Allergic conjunctivitis</td>
<td>100</td>
<td>4.0 (2.3-5.3)</td>
<td>1167</td>
</tr>
<tr>
<td>Skin symptoms (eczematous and urticarial)</td>
<td>100</td>
<td>4.0 (2.3-5.3)</td>
<td>1167</td>
</tr>
<tr>
<td>Total serum IgE &gt; 140 IU/100 ml.*</td>
<td>105</td>
<td>4.0 (2.3-5.3)</td>
<td>1167</td>
</tr>
</tbody>
</table>

Note: CI = confidence interval

*The social status of a family was defined by the highest social status grade completed by either the mother or the father of the study subject.

Results

Lifetime prevalence rates for the main allergic disease and characteristic symptoms are shown in Table 2. Allergic skin symptoms 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 III, prevalence rates were significantly different at an intermediate level (Table 2).

In the magnitude of total serum IgE, the relationship between social class and allergic sensitization, the subjects were stratified into a group with IgE levels above 100 IU/ml and a group with IgE levels below 100 IU/ml. Although children with high total serum IgE levels had significantly higher levels of allergic sensitization than children in the low I group, the effect of social class on allergic sensitization was evident in both groups (Table 2).

The distribution of health-relevant factors and lifestyle characteristics among subjects in the 3 social classes is presented in Table 3. These factors were assessed to elucidate 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 and social class was examined in a linear regression model. The results of the model are presented in Table 4. Inclusion of the IgE variable in the model resulted in a significant improvement in the model fit. The final model included all variables that remained statistically significant in the preliminary analysis.
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

<table>
<thead>
<tr>
<th>Atopic disease or symptom (questionnaire information)</th>
<th>Social class 1</th>
<th>Social class 2</th>
<th>Social class 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Prevalence, % (95% CI)</td>
<td>No.</td>
</tr>
<tr>
<td>Asthma or wheezy bronchitis³</td>
<td>191</td>
<td>4.7 (2.2, 8.8)</td>
<td>173</td>
</tr>
<tr>
<td>Wheezing (more than once)³</td>
<td>173</td>
<td>8.7 (4.9, 13.9)</td>
<td>1173</td>
</tr>
<tr>
<td>Eczema³</td>
<td>190</td>
<td>4.2 (1.8, 8.1)</td>
<td>1180</td>
</tr>
<tr>
<td>Eczematous rashes³</td>
<td>190</td>
<td>6.5 (4.9, 13.4)</td>
<td>1170</td>
</tr>
<tr>
<td>Allergic rhinitis³</td>
<td>190</td>
<td>1.1 (0.1, 3.8)</td>
<td>1180</td>
</tr>
<tr>
<td>Allergic reaction³</td>
<td>190</td>
<td>10.5 (6.5, 15.8)</td>
<td>1170</td>
</tr>
<tr>
<td>Atopic dermatitis (dermatologic examination)</td>
<td>163</td>
<td>0.0 (0.0, 2.2)</td>
<td>1053</td>
</tr>
<tr>
<td>Allergic sensitization (skin-prick test)</td>
<td>166</td>
<td>11.5 (7.1, 17.4)</td>
<td>1057</td>
</tr>
<tr>
<td>At least 1 of 12 tested allergens</td>
<td>165</td>
<td>3.0 (1.0, 5.9)</td>
<td>1057</td>
</tr>
<tr>
<td>Mite allergens only (der p1 or der 11)</td>
<td>165</td>
<td>5.5 (2.5, 10.1)</td>
<td>1057</td>
</tr>
<tr>
<td>Fungi allergens only (aspergillus, alternaria)</td>
<td>165</td>
<td>7.3 (3.8, 12.4)</td>
<td>1057</td>
</tr>
<tr>
<td>Pollen (local grasses, hazel, birch, plantain, mugwort)</td>
<td>165</td>
<td>0.0 (0.0, 2.2)</td>
<td>1057</td>
</tr>
<tr>
<td>Cat epithelium</td>
<td>165</td>
<td>8.5 (4.7, 13.8)</td>
<td>1057</td>
</tr>
<tr>
<td>At least 2 of 12 tested allergens</td>
<td>151</td>
<td>27.8 (20.8, 35.7)</td>
<td>904</td>
</tr>
</tbody>
</table>

Note. CI = confidence interval.

³The 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.
³Physician-diagnosed diseases as reported by parents.
⁴Perceived by parents.
⁵This 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: \( H_0: P_1 = P_\Pi \) vs \( H_1: P_1 \neq P_\Pi \)

2. The assumptions: Independent Random Samples
   Binomial Data

3. The \( \alpha \)-level: \( \alpha = 0.05 \)

4. The test statistic:
   \[
   z = \frac{p_1 - p_\Pi}{\sqrt{\frac{p_1(1-p_1)}{n_1} + \frac{p_\Pi(1-p_\Pi)}{n_\Pi}}}
   \]

5. The rejection region: Reject \( H_0: P_1 = P_\Pi \) if \( z \) is not between \( \pm 1.96 \)
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:

\[ n_I = 191 \quad n_{II} = 1,173 \]
\[ p_I = 0.047 \quad p_{II} = 0.078 \]
\[ C \left[ P_I - P_{II} - 1.96 \sqrt{\frac{P_I(1-P_I)}{n_I} + \frac{P_{II}(1-P_{II})}{n_{II}}} < P_I - P_{II} \right] = -0.95 \]

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

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

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

\[ C \left[ -0.0628 < P_I - P_{II} < 0.0008 \right] = 0.95 \]
Module 23: Proportions: Confidence Intervals and Hypothesis Tests, Two Samples

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

\[ P_1 = \text{Parameter for population one} \]
\[ P_2 = \text{Parameter for population two} \]

\[ x_1 = \text{Number in sample one with the characteristic} \]
\[ x_2 = \text{Number in sample two with the characteristic} \]

\[ n_1 = \text{Total number in sample one} \]
\[ n_2 = \text{Total number in sample two} \]

\[ p_1 = \frac{x_1}{n_1}, \text{estimate for sample one} \]
\[ p_2 = \frac{x_2}{n_2}, \text{estimate for sample two} \]
For proportions from two samples

\[ H_0: P_1 = P_2 \quad vs \quad H_1: P_1 \neq P_2 \]

Where: \[ p_2 = \frac{x_2}{n_2}, \quad p_1 = \frac{x_1}{n_1} \]

The test is based on:

\[ z = \frac{p_1 - p_2}{\sqrt{\frac{p_1(1-p_1)}{n_1} + \frac{p_2(1-p_2)}{n_2}}} \]
Appointments Keeping Behavior Re-Evaluated

PHILIP HERTZ, M.D., M.S.P.H., AND PAULA L. STAMPS, M.S., PH.D.

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 maintained a kept appointment rate of 83 per cent examined the relationship of broken appointments to age, sex, ethnic background, and payment mechanisms. The results suggest 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 15 per cent to 44 per cent. It is important to decrease the broken appointment rate as much as possible in order to generate the best utilization of the direct care staff members. Explanations of broken appointment rates have concentrated primarily upon factors related to the patient, with emphasis placed upon demographic characteristics, such as socioeconomic status, age, sex, and educational level, with other factors such as attitudes toward health care and personality factors also noted. Occasionally, additional factors have also been investigated, including the effects 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 concentrated upon 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 supported by several investigators over the last five years. The conclusion of the relationship between low income and high broken appointments has been proposed for ambulatory care in fee-for-service settings, psychiatric care, and ambulatory care in a pre-paid setting. The magnitude of the differences vary, but in one of the better-designed studies, Greenick contracted 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.4

Confounding variables with low social class include age, ethnicity, identification, and educational level. In general, the conclusion of most studies is that the older the patient, the higher the broken appointment rate, although Adler's study did not confirm this relationship for psychiatric patients. Social disorganization of urban families, especially lower-income families, has also been related to poor appointment keeping behavior.12

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. Increased efforts at communication, including various reminders for missed appointments, also seems to be effective in reducing the broken appointment...
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. An number of appointments kept and broken, sex, age, ethnic group, and payment mechanism. Chi-square was utilized at a significance level of .05 to test for the existence of relationships between these two 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 in the adult medical clinic during this time period.

**Results**

The overall kept appointment rate in the adult medical clinic during the study period was 62.6 per cent. 3,172 adult patients visited, and 44 per cent were male and 56 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, the data in Table 1 reveal a tendency for older patients in keeping 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 (92 per cent), with 7 per cent of the patients classified as White and 1 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 Rican having a higher broken appointment rate than either the White or Blacks. When these data are analyzed for individual months, it is observed that changes were present in the months of April, July, and August, February, and March.

Both of these persons play key roles in scheduling the Spanish-speaking patients. In November, February, and March the adult clinics were changed from their regular time 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 9.5 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 scheduling of medical clinics, and the changes in the clinic schedule that we 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.

In the post-Medicaid Medical Center patient population is an 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 appointment-keeping behavior, 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 problem.

**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 a significant difference in appointment-keeping behavior between the White and Puerto Rican patients and the non-English speaking staff was present, 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 presence of the bilingual appointment staff, the changes made in clinic days, and the physician.
<table>
<thead>
<tr>
<th>Patient Characteristic</th>
<th>N</th>
<th>% Kept (N = 2,683)</th>
<th>% Kept (N = 489)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex ^1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1,109</td>
<td>85.39</td>
<td>14.61</td>
</tr>
<tr>
<td>Female</td>
<td>2,063</td>
<td>64.15</td>
<td>15.88</td>
</tr>
<tr>
<td>Age ^2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 45</td>
<td>2,683</td>
<td>83.00</td>
<td>17.00</td>
</tr>
<tr>
<td>45+</td>
<td>489</td>
<td>90.37</td>
<td>9.63</td>
</tr>
<tr>
<td>Ethnicity ^3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Puerto Rican</td>
<td>2,206</td>
<td>81.46</td>
<td>18.54</td>
</tr>
<tr>
<td>White</td>
<td>837</td>
<td>91.52</td>
<td>8.48</td>
</tr>
<tr>
<td>Black</td>
<td>129</td>
<td>93.02</td>
<td>6.98</td>
</tr>
<tr>
<td>Payment Mechanism ^4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Welfare</td>
<td>2,229</td>
<td>63.40</td>
<td>16.60</td>
</tr>
<tr>
<td>Non-Welfare</td>
<td>943</td>
<td>87.38</td>
<td>12.62</td>
</tr>
<tr>
<td>TOTAL</td>
<td>3,172</td>
<td>84.58</td>
<td>15.42</td>
</tr>
</tbody>
</table>

^1X^2 = 8.54; df = 1; p > .05
^2X^2 = 24.22; df = 1; p < .05
^3X^2 = 53.94; df = 2; p < .05
^4X^2 = 8.05; df = 1; p > .05
Proportions for Two Independent samples

1. The hypothesis: \( H_0: P_M = P_F \quad \text{vs} \quad H_1: P_M \neq P_F \)

2. The assumptions: Independent random samples

3. The \( \alpha \)-level: \( \alpha = 0.05 \)

4. The test statistic:

\[
z = \frac{p_m - p_s}{\sqrt{\frac{p_m(1-p_m)}{n_m} + \frac{p_s(1-p_s)}{n_s}}}\]

5. The rejection region: Reject if \( z \) not between \( \pm 1.96 \)
6. The test result:

\[ p_M = \frac{x_M}{n_M} = \frac{947}{1109} = 0.8539 = 0.85 \]
\[ p_F = \frac{x_F}{n_F} = \frac{1736}{2063} = 0.8415 = 0.84 \]

\[ z = \frac{0.85 - 0.84}{\sqrt{\frac{0.85(1-0.85)}{1109} + \frac{0.84(1-0.84)}{2063}}} \]

\[ z = \frac{0.01}{\sqrt{0.000115 + 0.000065}} \]

\[ z = \frac{0.01}{\sqrt{0.000180}} \]
\[ z = \frac{0.01}{0.013422} \]

\[ z = 0.745 \]

7. The conclusion: Accept \( H_0 : p_M = p_F \) since \( z \) is between \( \pm 1.96 \)