Small-Area Analysis: Targeting High-Risk Areas For Adolescent Pregnancy Prevention Programs

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Context: *Traditional methods of identifying areas in need of adolescent pregnancy prevention programs may miss small localities with high levels of adolescent childbearing.*

Methods: *Birthrates for 15–17-year-olds were computed for all California zip codes, and the zip codes with birthrates in the 75th percentile were identified. Panels of local experts in adolescent pregnancy reviewed these "hot spots" for accuracy and grouped them into potential project areas, based on their demographics, geography and political infrastructure.*

Results: *In all, 415 zip codes exceeded the 75th-percentile cut-off point of 62.8 births per 1,000, and 210 of them differed significantly from the state average of 44.5 per 1,000 for 15–17-year-olds. While all had high adolescent birthrates, they varied greatly in racial and ethnic mix, poverty and educational attainment, and certain perinatal measures such as inadequate prenatal care and repeat pregnancy.*

Conclusions: *The use of zip code–level data holds promise for more effective program planning and intervention.*

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High adolescent fertility is an important public health problem in the United States.[1] In California, the expansion of intervention programs to meet the U.S. Public Health Service's objective for the year 2000 of no more than 50 pregnancies per 1,000 girls aged 17 or younger is an important public health priority.[2] During 1992–1994, an average of 70,426 births occurred annually to female California residents aged 10–19; 40% were to adolescents aged 17 or younger.

Traditionally, two approaches have been used to identify and allocate resources to areas with high levels of adolescent fertility. The first consists of selecting the counties with the highest rates of adolescent births. The major limitation of a county-level approach is that high adolescent fertility may be a local, rather then a county-wide, problem. Thus, communities with high adolescent fertility that are located in counties with low adolescent fertility overall are unlikely to be identified.

The second traditional approach is to rely on a local needs assessment, which is often used as part of a process to request funding allocations. While this process allows resources to be directed to specific locations within a county, only counties or localities with individuals who have grant-writing experience and with the resources to develop a proposal will be in a position to participate. Thus, the use of such a process to identify localities with high levels of adolescent childbearing is a passive approach, with often inconsistent results.

The methodology described in this article was developed to transcend the limitations of both approaches. Its goal is to use existing data to identify small areas with high levels of adolescent childbearing. The method is an active approach to identify what can be defined as "hot spots" for adolescent births, even when they are located in counties or communities where adolescent births are not considered a universal problem. In a time of limited resources, such mapping has become increasingly imperative to ensure the most judicious use of the resources that are available. The methodology also has potential for use in measuring specific outcomes for targeted program interventions over time and comparing communities that are testing the efficacy of different kinds of interventions.

Methodology

Our "geomapping" approach is possible because the United States' 1990 census data file contains the age distribution for each California zip code and because California birth certificates include both maternal age and the zip code of maternal residence. Using the zip code as our smallest geographic unit, we determined the number of births occurring to female teenagers in each zip code and identified the zip codes that had the highest teenage birthrates.

Our analysis was based on population estimates of the number of adolescent women in each zip code during 1992–1994; these estimates were derived from projections calculated from the 1990 census, using county-level inflow and outflow adjustments obtained from the annual publications of the California Department of Finance.[3] This approach assumes that the population of female adolescents within each zip code in any given county grew or shrank at the same rate. Although results may not be accurate in situations where parts of a county have experienced rapid population shifts, it is the only practical way of estimating the number of female adolescents per zip code during an intercensal period.

We obtained the number of births in each adolescent age-group per zip code during 1992–1994 from the State of California Vital Statistics Files.[4] We then calculated the birthrate for women aged 15–17 for each zip code. We also estimated zip code–level birthrates for adolescents aged 10–14 and for those aged 18–19. Because the annual number of teenage births occurring in some zip codes was very small, we combined data from the years 1992–1994 (the most recent years for which information was available) to provide more accurate estimates of the birthrate for each adolescent age-group. The number of years that can be combined varies from state to state, depending on the stability of risk and intervention. Our project advisory committee—an expert group that had academic, programmatic and state government representation—recommended that we not combine California data be-

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Table 1. Procedure for identifying potential project areas for adolescent pregnancy prevention programs

Identification of "hot spot" zip codes for teenage births
Select indicator (birthrate for 15–17-year-olds)
Rank all zip codes
Identify zip codes with birthrates in the
 75th, 90th and 95th percentiles
Determine if birthrates in these "hot spots"
 differ significantly from state average
Prepare tables and maps showing hot spots

Review of hot spots by local experts
Verify hot spots
Aggregate hot spots into potential project areas
Name potential project areas

Classification of potential project areas
Estimate birthrate for 15–17-year-olds
Determine yearly caseload (births to
 adolescents <18 years)
Identify pattern of birthrates across age-groups
Map project areas indicating priority
 level and caseload
Characterize potential project areas by:
 Racial and ethnic composition
 Socioeconomic characteristics
 Pregnancy-related variables

yond the three most recent years.*

To identify potential project areas, we focused solely on birthrates among 15–17-year-olds. Including births to adolescents younger than 15 and to those aged 18–19 would have increased the number of births in each zip code. However, we omitted births to adolescents younger than 15 because their birthrate is very low. We also decided not to include births to 18–19-year-olds because they are less likely to be nonmarital and are less likely to have detrimental consequences than are births to younger teenagers. Our final rationale for using the birthrate for 15–17-year-olds as our assessment indicator is that it is consistent with the statement of goals for the Year 2000.

Table 1 outlines our analytic approach. The first step was to identify "hot spot" zip codes—those with the highest adolescent birthrates. We ranked all California zip codes by their birthrate for 15–17-year-olds and then determined the 75th-, 90th- and 95th-percentile cut-off points (the lowest birthrate in each percentile), weighted by the number of women aged 15–17 living in the zip code.

*Combining more years would have increased the number of births and therefore might have improved the accuracy of our birthrate estimates, but it might also have obscured marked changes in levels of teenage childbearing and in access to intervention services for reducing adolescent pregnancy during the period covered. For example, consider a rural area with historically low adolescent fertility that has had an influx of high-risk urban youths over the last two years, resulting in a much higher teenage birthrate. If the last four years are combined, this change may be masked. Likewise, in an area that has generally had high adolescent fertility, the effectiveness of a two-year-old intervention program in lowering the birthrate could be obscured if the last four years are combined.

Although we selected potential project areas based solely on birthrates for 15–17-year-olds, we also carried out the ranking process using the birthrates for younger and older adolescents in order to develop a more complete picture. Zip codes in which the birthrate for one or more of the age-groups was in the 75th percentile were considered hot spots for that particular age-group. For zip codes in which the birthrate for any one of the three age-groups was in the 75th percentile, we prepared tables that presented the number of adolescents, the number of births and the birthrate for each age-group, highlighting those that differed significantly from an age-group's mean birthrate in California as a whole ($p<.01$ by an approximation of the exact Poisson test).

Finally, we developed a series of maps for each age-group, indicating zip codes with a birthrate falling between the 75th- and 90th-percentile cut-off points, those between the 90th- and 95th-percentile cut-off points, and those in the 95th percentile. The maps also showed which zip codes had birthrates significantly different from the state mean.

The second step was a review by local experts to verify that the indicated hot spots matched clinical experience, to aggregate hot spot zip codes into potential project areas and to provide appropriate names for these areas. California was divided into five convenience regions (Northern, Bay Area, Central, Los Angeles and Southern California). We prepared tables and maps for each region and organized regional meetings to which we invited individuals identified by the California State Office of Family Planning as being highly experienced in planning programs for or providing direct services to adolescents.

Each meeting was attended by 15–25 professionals from a wide variety of disciplines and programs. The meetings lasted approximately five hours and were conducted and recorded, in collaboration with the principal investigator, by a professional facilitator who had experience with adolescent pregnancy prevention projects in California and knew many of the participants personally. An overhead projector was used for map orientation, but each participant was given an individual set of tables and maps.

Following a two-hour methodology workshop with exercises in reading and interpreting maps and tables, participants were divided into subgroups familiar with specific parts of the region. These groups were asked to review their area's maps and tables for accuracy and to identify clusters of hot spot zip codes that could be combined into potential project areas. Each subgroup then presented a review of their area, along with a rationale for aggregating groups of zip codes into potential project areas.

Collectively viewing the maps on the overhead projector with the entire group promoted lively discussions. The project area aggregations were guided by considerations of geography, travel time, social and demographic distinctions, infrastructure and traditional health service catchment areas. The potential project areas were then named according to local use. Following the meeting, these designations were reviewed by a project member familiar with the organization of health care services in California. Potential project areas that did not seem coherent with respect to social and demographic composition or that combined several service catchment areas were reviewed by a second set of local consultants.

The third step was to classify potential project areas by three criteria—the birthrate for 15–17-year-olds, the yearly number of births to women younger than 18 and the pattern of adolescent birthrates seen across the three age-groups. Potential project areas in which the birthrate for 15–17-year-olds was in the 90th percentile were considered the highest priority for intervention, while those in which the birthrate fell between the 75th- and 90th-percentile cut-off points were considered second priority.

Areas with 40 or more births to women younger than 18 were considered to have a high potential caseload, and those with fewer than 40 births were considered to have a low potential caseload. These arbitrary classifications were made in consultation with our advisory committee.

The patterns of birthrates across age-groups were classified as follows. In pattern A, all three age-groups had birthrates in the 90th percentile for first-priority areas (or between the 75th and 90th percentile cut points for second-priority areas). Zip codes in which the birthrates for adolescents younger than 15 and those aged 15–17 fell into these categories were termed type B, while those in which the birthrates for 15–17-year-olds and 18–19-year-olds and those in which only the birthrate for 15–17-year-olds met these criteria were termed types C and D, respectively.

To locate the potential project areas, we developed a set of maps that used color to distinguish the first- and second-priority areas, with solid colors indicating high-caseload areas and hatched colors designating low-caseload areas.

The final step was to characterize the potential project areas in terms of factors that could be useful in guiding program design. These factors included racial and ethnic composition, socioeconomic characteristics (educational gap,* median family income, percentage of population and of children living in poverty, percentage of households with a female head and percentage of population unemployed), and characteristics related to adolescent pregnancy (percentage of repeat adolescent births, percentage of adolescents with third-trimester or no prenatal care, percentage of low-birth-weight babies born to adolescents, percentage of deliveries paid by Medicaid, and, among babies born to adolescent mothers, percentage with fathers aged younger than 20, 20–24, and older than 24). This information was obtained from the Improved Perinatal Outcome Data Management system (IPODM), a zip code–level geographic information system on perinatal health and outcomes for California.[5]

A complete set of maps and tables for the upper-quartile zip codes and the potential project areas is available on the Internet at: <http://ucdata.berkeley.edu /TCHT/>.

Results

During 1992–1994, about 12% of the average of 584,786 births occurring each year in California were to adolescents. Among all births to adolescents, 2% were to 10–14-year-olds (a birthrate of 1.5 per 1,000), 37% were to 15–17-year-olds (44.5 per 1,000) and 60% were to 18–19-year-olds (108.0 per 1,000). We rank ordered California's zip codes according to the birthrate for 15–17-year-olds and noted the number of 15–17-year-old women in each zip code. We then determined the zip codes that fell into the 75th, 90th and 95th percentiles—that is, those that contained the 25%, 10% and 5%, respectively, of the state's 15–17-year-old females with the highest zip code-level birthrates. The 75th-percentile cut-off points were 2.2 births per 1,000 for 10–14-year-olds, 62.8 per 1,000 for 15–17-year-olds and 150.0 per 1,000 for 18–19-year-olds (Table 2).

We designated potential project areas by aggregating zip codes with 75th-percentile birthrates for 15–17-year-olds that differed significantly from the mean statewide birthrate for that age-group. There were 415 zip codes with birthrates that exceeded the 75th-percentile cut-off point of 62.8 births per 1,000. Only 210 of these zip codes had rates that were significantly different (at p<.01) from the state average of 44.5 births per 1,000 for 15–17-year-olds. These zip codes accounted for 96% of all births to 15–17-year-olds in 75th-percentile zip codes. Because the remaining zip codes may not have differed significantly from the state mean only because of small numbers of adolescents, we included them (with a clear indication of their status) in the regional tables and maps to enhance local analysis.

Of the 210 hot spot zip codes for 15–17-year-olds, 178 (85%) were also hot spots for at least one of the other two age-groups. For example, the birthrates for all three age-groups were in the 75th percentile in 60 zip codes (29%), and the birthrates for both 15–17-year-olds and 18–19-year-olds were in the 75th percentile in 111 zip codes (53%). Hot spots for the youngest adolescents were always hot spots for another age-group as well (seven hot spots shared with 15–17-year-olds and two shared with 18–19-year-olds). Sixty-one zip codes were hot spots only for 18–19-year-olds.

In the five regional meetings, the local planners and providers confirmed that all of our 75th-percentile zip codes for 15–17-year-olds were seen as problem areas for adolescent childbearing. Furthermore, the meetings brought to light only four zip codes that had not been identified as hot spots. All four were heterogeneous and contained both a high-risk and a low-risk population of adolescents.

The local review of our maps and tables to group hot spot zip codes into potential project areas was crucial. For example, the Fresno area consists of a contiguous cluster of 75th-, 90th- and 95th-percentile hot spots. Without local review, we probably would have aggregated these zip codes into a single potential project area. Our local experts, however, informed us that there were marked differences across this area ("rural Hispanic, becoming urban Hispanic as one moves east, abruptly changing to African American..."). What the map suggested as a single project area was better divided—according to demographics, infrastructure and tradition—into five distinct project areas.

Based on local review, we aggregated California's 210 hot spots into 82 potential project areas (Table 3). Fifty-six project areas had a yearly caseload of at least 40 births (with a mean of 216 and a range of 41–1,329), and 26 areas had a yearly caseload of fewer than 40 births (mean, 23; range, 4–35). Within the high-caseload group, 26 areas were considered first priority because their birthrate for 15–17-year-olds exceeded the 90th-percentile cut-off point of 80.7 per 1,000, while 30 areas were considered second priority because they had birthrates below that cut-off point but above 62.8 per 1,000 (the 75th-percentile cut-off point). Of the 26 low-caseload project areas, 11 had birthrates for 15–17-year-olds in the 90th percentile and were thus considered first priority.

For the purpose of program planning, we further characterized the project areas according to their location (region and county, not shown), race and ethnicity, socioeconomic status and pregnancy-related factors. Table 4 (page 176) shows that for the 56 high-caseload project areas, the average birthrate for 15–17-year-olds was 84.6 births per 1,000 in the 26 first priority areas and 71.0 per 1,000 in the 30 second-priority areas. When compared with California as

Table 2. Number of adolescents, and number of births per 1,000 teenage women, by cut-off points for 75th, 90th and 95th percentiles for zip code–level birthrates, according to age-group, California, 1992–1994

Age-group	No. of women	Total	75th percentile	90th percentile	95th percentile
10–14	1,073,832	1.5	2.2	3.3	4.1
15–17	590,264	44.5	62.8	80.7	93.4
18–19	393,825	108.0	150.0	191.0	213.0

Note: Cut-off points are weighted by number of adolescent women in each age-group per zip code. *Source:* California Improved Perinatal Outcome Data Management database.

Table 3. Number of potential project areas constructed from aggregated "hot spot" zip codes, by caseload and priority, according to age-related birthrate patterns

Caseload and priority	Total	Birthrate pattern*			
		A	B	C	D
All	82	37	10	23	12
High caseload (≥40 births per year)	56	27	8	14	7
First priority	26	8	5	8	5
Second priority	30	19	3	6	2
Low caseload (<40 births per year)	26	10	2	9	5
First priority	11	6	0	3	2
Second priority	15	4	2	6	3

*Birthrate patterns indicate which adolescent age-groups have birthrates considered "high"—i.e., exceeding the cut-off point for the 90th percentile (first priority) or falling between the cut-off points for the 75th percentile and the 90th percentile (second priority): Pattern A—all three age-groups; pattern B—10–14-year-olds and 15–17-year-olds; pattern C—15–17-year-olds and 18–19-year-olds; and pattern D—18–19-year-olds only. *Source:* California Improved Perinatal Outcome Data Management database.

*The difference between the population's expected and observed years of education, for age.

Table 4. Means of characteristics for California and for high-caseload potential project areas, by priority

Characteristics	State mean	First priority (N=26)		Second priority (N=30)	
		Mean	Range	Mean	Range
Births among 15–17-year-olds					
No.	26,263	273	53–1,242	140	40–54
Rate	43.9	84.6	81.0–168.0	71.0	64.0–78.0
Race/ethnicity					
% non-Hispanic white	20.5	1.4	0.3–35.0	16.5	1.1–55.0
% Hispanic	61.6	58.5	22.0–94.0	45.0	23.0–95.0
% black	12.3	38.2	0.6–75.0	31.6	0.0–63.0
Socioeconomic					
Median family income	$33,249	$22,117	$18,362–36,270	$28,298	$18,563–38,031
% population in poverty	17.8	27.7	15.0–39.0	22.1	11.0–30.0
% children <18 in poverty	24.5	39.0	20.0–52.0	30.2	16.0–41.0
Educational gap*	0.10	0.11	0.06–0.19	0.15	0.04–0.14
Pregnancy-related					
% higher order births	13.7	15.2	7.6–25.0	15.0	10.0–23.0
% inadequate prenatal care	9.2	11.3	4.4–18.0	11.9	4.7–21.0
% low-birth-weight	7.9	9.1	4.9–14.0	8.4	5.1–14.0
% Medi-Cal delivery	76.4	79.5	77.0–92.0	79.5	63.0–94.0
% nonmarital births	76.6	77.3	63.0–89.0	77.5	57.0–86.0

*Expected minus observed years of education.

a whole, these project areas had fewer adolescent births than expected among non-Hispanic whites, slightly fewer among Hispanics and markedly more among blacks.

When compared to the overall profile of California, the potential project areas were economically disadvantaged, with the highest levels of disadvantage in the first-priority areas. The median family income (weighted by the number of births) was $22,117 in first-priority areas and $28,298 in second-priority areas, compared with $33,249 in all California zip codes with adolescent births.

Potential project areas also did not fare as well as California as a whole with respect to pregnancy-related characteristics, such as adequate prenatal care and higher order births (Table 4), but the characteristics of first- and second-priority areas were similar. Although the general observations of minority overrepresentation, poverty and increased perinatal need are important, the most striking feature of the potential project areas is their variability, as indicated by the wide range seen for many of the characteristics. Because of this lack of homogeneity, project area rankings may vary sharply, depending on the characteristic chosen for ranking. For example, Fresno ranked first in the proportion of children younger than 18 living in poverty, but ranked only 18th in the proportion of births to 15–17-year-olds occurring among blacks.

Of the 26 potential project areas with low caseloads (not shown), the 11 first-priority areas had a mean caseload of 17 births, while the 15 second-priority areas had a mean caseload of 27 births. Although the high-caseload and low-caseload areas were similar in overall profile, the low-caseload areas had a higher percentage of births to non-Hispanic white adolescents, a slightly lower proportion of the population living in poverty, less of an educational gap and a lower proportion of infants whose mother had inadequate prenatal care. Adolescent mothers in the low-caseload areas tended to have an increased number of higher order births (details available from the first author on request).

Discussion

This article has described a small-area methodology that was successful in identifying and characterizing 82 potential project areas for adolescent pregnancy prevention programs in California. The method requires that one be able to estimate adolescent birthrates at the zip code level. Because of the availability of data giving the zip code of maternal residence in most state birth certificate files and zip code–level demographic data from the U.S. census, this estimation should be possible for most states.

Success in using this technique depends not on the data analysis, which is straightforward, but on the ability to develop and establish a strong collaborative approach. A statewide expert advisory board is needed to assist in making the very important but relatively arbitrary decisions required by the analysis. It is also crucial that local expert groups be formed and that effective forums be developed to assure that the findings of the zip code analysis match clinical experience and to allow hot spots to be grouped into appropriate and resource-efficient potential program areas.

This technique could be very useful in identifying local areas of need located in communities and counties where adolescent births are not a universal problem. It also helps to encourage members of the local community to "buy into" the program and creates consensus for developing specially tailored adolescent pregnancy prevention programs designed to operate within a community context.

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