11-6-2017

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Geoffrey R. Swain

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Recommended Citation

LeCounte ES, Swain GR. Life expectancy at birth in Milwaukee County: a zip code-level analysis. J Patient Cent Res Rev. 2017;4:213-20. doi: [10.17294/2330-0698.1576](https://doi.org/10.17294/2330-0698.1576)

Published quarterly by Midwest-based health system Advocate Aurora Health and indexed in PubMed Central, the Journal of Patient-Centered Research and Reviews (JPCRR) is an open access, peer-reviewed medical journal focused on disseminating scholarly works devoted to improving patient-centered care practices, health outcomes, and the patient experience.

Life Expectancy at Birth in Milwaukee County: A Zip Code-Level Analysis

Erica S. LeCounte, MPH,¹ Geoffrey R. Swain, MD, MPH^{2,3}

¹City of Milwaukee Health Department, Milwaukee, WI; ²Department of Family Medicine and Community Health, University of Wisconsin School of Medicine and Public Health, Madison, WI; ³Center for Urban Population Health, Milwaukee, WI

Purpose	Life expectancy at birth is used as a barometer of the health and well-being of a population. Life expectancies vary widely across Wisconsin counties. While much of the analysis of life expectancy in Wisconsin has focused on counties, there may be important differences in life expectancy within counties by zip code.
Methods	To calculate life expectancy, death count data and population estimates were entered into an abridged life table using the Chiang methodology. Data were linked with measures from the American Community Survey to examine the relationship between life expectancy and zip code characteristics.
Results	Life expectancy varies greatly across zip codes in Milwaukee County. Overall, there was a 12-year difference in the life expectancy of children born into zip codes with the lowest and highest life expectancy: 53206 (71.3 years) and 53217 (83.2 years). There was a strong positive correlation between life expectancy and median household income ($r=0.784$, $P<0.0001$), educational attainment of a bachelor's degree or higher ($r=0.741$, $P<0.0001$) and the socioeconomic index combining education and income ($r=0.819$, $P<0.0001$).
Conclusions	Disparities in life expectancy within Milwaukee County are stark and correlate with differences in social and economic factors. To improve health outcomes such as life expectancy, health care practitioners and health care systems must become more involved in activities at the social and policy levels to improve social and economic conditions that would allow their patients to live healthier and longer lives. (<i>J Patient Cent Res Rev</i> . 2017;4:213-220.)
Keywords	life expectancy, Milwaukee County, zip code, health care, social determinants of health

Life expectancy at birth represents the average number of years a group of infants can expect to live if they are subject to the age-specific death rates prevailing in the population at their time of birth.¹ It is a measure often used as a barometer of the health and well-being of a population. Children born in Wisconsin between 2010 and 2014 have, on average, a life expectancy of 79.6 years.²

This life span, however, varies substantially depending on where in the state a baby is born. For instance,

children born in Milwaukee County during the same time period have a life expectancy of 77.6 years, which is tied with Forest County for having the state's fifth-shortest life expectancy at birth (Menominee County has the state's shortest life expectancy at 72.5 years).² In comparison, children born in Kewaunee County have a life expectancy of 82.0 years, which is higher than any other county in Wisconsin and more than 4 years longer than for children born in Milwaukee County.²

Much of the analysis of life expectancy at birth in Wisconsin has focused primarily on counties, revealing the 9.5-year difference between Menominee and Kewaunee counties.^{2,3} However, analyses elsewhere have revealed very important geographical differences in life expectancy within counties at the zip code

Correspondence: Erica S. LeCounte, MPH,
841 N. Broadway, 3rd Floor, Milwaukee, WI, 53202,
T: +1-414-286-5171, Email: elecou@milwaukee.gov

level.^{4,5} Therefore, children born into different zip codes in Milwaukee County (or other counties throughout Wisconsin) — even if those zip codes are only a few miles apart — might have very different life experiences. This may lead to some children having much shorter life expectancies than others, even within a single county. To our knowledge, life expectancy analysis at the individual zip code level has not been done in Wisconsin, although it has been conducted in other cities and counties in the United States.^{4,5}

As described in the County Health Rankings Model,⁶ there are many factors that contribute to health outcomes such as length of life (life expectancy). Access to health care is one of them. However, it is important to recognize that access to health care, while necessary, is not the primary driver of life expectancy.⁶ In fact, geographical disparities in life expectancy are not primarily driven by differences in health care access or quality, but rather mainly by differences in the social, economic and environmental conditions in which children are raised.⁶ According to the County Health Rankings Model, only 20% of the factors contributing to health outcomes like life expectancy can be attributed to access to and quality of health care, whereas 50% are driven by a combination of social and economic factors and the physical environment.⁶ Subsequent analyses have confirmed these model weightings.⁷

Various health, religious and community agencies within Milwaukee County have expressed interest in comparing the life expectancy at birth of children born into different Milwaukee zip codes. This analysis will measure and examine intracounty differences in life expectancy by analyzing life expectancy at birth for children born into each of the 35 zip codes in Milwaukee County. It also will examine some of the social and economic factors within each zip code that may contribute to any geographical disparities in life expectancy.

METHODS

Life expectancy at birth by zip code is an estimate of how long a child born into a particular zip code (based on the child's zip code of residence at the time of birth) can be expected to live, assuming that the age-specific mortality rates that exist in that zip code (at their time of birth) remain the same throughout the child's life.¹ To calculate life expectancy at birth in Milwaukee County zip codes, final aggregate death numbers for the years

of 2010 to 2014, in addition to population estimates for 2010, were gathered for Milwaukee County residents. All aggregate data were stratified into 5-year age groups according to the age at time of death (<5, 5–9, 10–14, 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59, 60–64, 65–69, 70–74, 75–79, 80–84, 85+) and by each decedent's residential zip code. Death counts and population estimates were entered into an abridged life table, which used the Chiang methodology to compute life expectancy at birth.⁸ Death count data were obtained from the Wisconsin Department of Health Services Division of Public Health's Office of Health Informatics. Population estimates were retrieved from the 2010 decennial census.

To examine hypotheses that social and economic factors may help explain geographical variations in life expectancy at birth within Milwaukee County, life expectancy numbers were linked with aggregate data from the 2010–2014 American Community Survey by zip code to evaluate the relationship between life expectancy and zip code characteristics. This was done with Pearson correlation measures. The zip code characteristics included measures of median household income and educational attainment (proportion of residents with a bachelor's degree or higher). In addition, both measures were combined to create an index for socioeconomic status using the approach of Mustard and Frohlich, as modified in 2007 by Vila et al.⁹ Data analysis was conducted using SAS statistical software (SAS Institute Inc., Cary, NC).

RESULTS

Data were sufficient to compute life expectancy at birth for 34 of the 35 zip codes in Milwaukee County. Life expectancy could not be determined for zip code 53203 because it is mostly composed of businesses and does not have an adequate number of residents (or deaths) in order to compute life expectancy.

Overall, there were noticeable geographical differences when comparing the life expectancies at birth for children born into each of the zip codes in Milwaukee County between 2010 and 2014. As shown in Figure 1, life expectancies in Milwaukee zip codes range from as low as 71.3 years to as high as 83.2 years. Thus, there is nearly a 12-year difference in the life expectancies of children born across the zip codes within Milwaukee County.

Figure 1. Life expectancy at birth in Milwaukee County by zip code, 2010–2014.

From 2010 to 2014, the life expectancy at birth in Milwaukee County was highest among children born into zip code 53217, which is home to children living in the villages of River Hills, Fox Point, Bayside, Whitefish Bay and the city of Glendale. Children born into this zip code had a life expectancy of 83.2 years. Residents of zip code 53217 are predominately white (89.4%), highly educated (76.1% of the population having received a bachelor's degree or higher), and relatively affluent (median household income: \$97,690; poverty rate: 4.6%).¹⁰

In comparison, children born into zip code 53206 had a life expectancy of 71.3 years, the shortest life expectancy in the county. This zip code lies within the city of Milwaukee. Residents living in zip code 53206 are mostly black (93.6%), have relatively lower levels of education (21.6% with a bachelor's degree or higher), and have relatively low economic status (median household income: \$22,468; poverty rate: 49.6%).¹⁰

Figure 2 further illustrates broad trends in the geographical variation in life expectancy at birth by

Figure 2. Life expectancy at birth (years) by zip code within Milwaukee County, 2010–2014.

zip code quintiles. There were 6 zip codes in the lowest quintile for life expectancy: 53225, 53218, 53210, 53206, 53205 and 53212. Children born into these zip codes during the 2010 to 2014 time period have average life expectancies ranging from 71.3 to 73.9 years. On the other hand, children born into the quintile with the highest life expectancy at birth (ie, 53217, 53211, 53213, 53226, 53130, 53129 and 53132) have average life expectancies ranging from 80.0 to 83.2 years. See Table 1 for sociodemographic characteristics of quintiles.¹⁰

Correlations between life expectancy and selected zip code characteristics are shown in Figures 3–5. There was a strong positive correlation between life expectancy and median household income ($r=0.784$, $P<0.0001$, $r^2=0.615$; Figure 3), educational attainment of a bachelor's degree or higher ($r=0.741$, $P<0.0001$, $r^2=0.545$; Figure 4), and the combined education and income socioeconomic index ($r=0.819$, $P<0.0001$, $r^2=0.671$; Figure 5). Based on the r^2 values for each zip code measure, 55% of the variation in life expectancy is explained by variations in educational attainment, 62% of the variation in life expectancy by zip code is explained by variations in median household income, and a full 67% is explained by variations in the combined income and education socioeconomic index.

DISCUSSION

Throughout Milwaukee County there are very clear differences in how long a baby can be expected to live

based on the zip code in which they are born. The 12-year difference in the life expectancy of children born into zip codes with the lowest and highest life expectancy within the county greatly exceeds the differences between Wisconsin counties overall. Yet these disparities by zip code are very consistent with disparities seen in other health outcomes by zip code such as infant mortality, teen births, lead poisoning and obesity.¹¹⁻¹²

Disparities in life expectancy by zip code are due to a number of factors. Access to health care and the quality of health care a person receives throughout his or her life are important and necessary components to determining how long a person will live.⁶ However, studies have suggested that health and longevity may be more strongly influenced by social and economic factors such as income, education, employment, social support and the level of community safety that residents living in each zip code are experiencing.^{6,7}

Results from the Pearson correlation analysis showed very strong associations between life expectancy at birth in Milwaukee County zip codes and income, education and the combined income and education socioeconomic status index. This strongly suggests that children born into zip codes with a higher median household income, higher levels of education and higher overall socioeconomic status can expect to live significantly longer on average than children born into zip codes with lower levels. Results also revealed that

Table 1. Sociodemographic Characteristics of Milwaukee County Residents by Zip Code Quintile

Measure	Quintile 1 (71.3–73.9)*	Quintile 2 (74.0–75.9)*	Quintile 3 (76.0–77.9)*	Quintile 4 (78.0–79.9)*	Quintile 5 (80.0–83.2)*
Zip code	53205, 53206, 53210, 53212, 53218, 53225	53208, 53209, 53214, 53216, 53233	53110, 53172, 53202, 53204, 53215, 53219, 53223, 53224	53154, 53207, 53220, 53221, 53222, 53227, 53228, 53235	53211, 53213, 53217, 53129, 53130, 53132, 53226
Median household income (range among zip codes)	\$31,090 (\$22,468–\$39,348)	\$30,167 (\$13,544–\$42,209)	\$35,681 (\$33,129–\$51,499)	\$51,825 (\$45,987–\$64,570)	\$65,950 (\$46,241–\$97,690)
Bachelor's degree or higher	15.3%	21.9%	24.7%	28.6%	49.0%
Minority race	80.4%	60.3%	34.7%	14.2%	10.5%

*Quintile ranges indicate life expectancy in years.

Figure 3. Scatterplot of correlation between life expectancy at birth and median household income.

Figure 4. Scatterplot of correlation between life expectancy at birth and educational attainment.

Figure 5. Scatterplot of correlation between life expectancy at birth and socioeconomic index (z-score).

variations in educational attainment and in income played a major role in explaining the disparities in life expectancies across zip codes.

It is not surprising that both income and educational attainment were highly correlated with life expectancy, not only based on what is known about the power of social and economic factors in determining health outcomes, but also because income and educational attainment are themselves generally highly correlated. In fact, we found a high correlation between income and educational attainment across Milwaukee County zip codes ($r=0.735$, $P<0.0001$, $r^2=0.541$).

The results of our analysis are very similar to the findings of life expectancy analyses performed in other locations. One example of this lies in California. In the 2011 report by Measure of America, life expectancy analysis was conducted at various geographical levels, including the state, county, metro area and neighborhood levels.¹³ Although their analysis did not include zip code, authors Burd-Sharps and Lewis

did find that the greatest geographical variations in health outcomes (including life expectancy), as well as health factors such as education and income, were within rather than between counties.¹³ They discovered almost a 12-year difference between the neighborhood clusters with the lowest and highest life expectancy at birth.¹³ The neighborhoods with the lowest life expectancy also had the lowest percentage of people with at least a bachelor's degree, the lowest median income earnings and the worst scores on the American Human Development Index (which measures the level of household and community risks to healthy child development and well-being) when compared to neighborhoods with higher life expectancies.¹³

There are a number of mechanisms by which social and economic factors can influence health outcomes such as life expectancy.¹⁴ According to Swain et al (as well as other researchers), these mechanisms include affecting access to and quality of health care; supporting or constraining people's ability to practice healthy behaviors; and directly affecting people's

physiology through chronic elevations of stress hormones, epigenetic changes and other biologic mechanisms across the life course.¹⁴ People who have higher levels of income, for instance, have greater access to health care, are able to practice healthier behaviors due to greater access to grocery stores and/or safe and walkable neighborhoods, are able to pursue higher levels of education (and thus safer and better paying jobs), and often have lower levels of chronic, toxic, unmitigated stress.

Although we (and others) have shown dramatic differences in life expectancy and other health outcomes at the zip code level, it does not follow that only specific zip codes should be necessarily targeted for policy or programmatic interventions. The chances that a given individual will be healthy or not are driven by socioeconomic factors at both the individual level (eg, a given patient's own level of income or education, or other sources of chronic stress) and the community level (eg, the degree of concentrated disadvantage that a given patient is exposed to in their community). But even individuals who are not exposed to high levels of concentrated disadvantage or other forms of chronic stress in their zip code of residence will be likely to have poorer health outcomes if they are relatively worse off educationally or financially, for example.

Moreover, although our study focused on Milwaukee County, these higher-risk social and economic factors can be present at the individual level in *every* county and zip code of the state. They also may be found at the population level in many counties, zip codes and neighborhoods in the state, even those that may seem superficially quite different from Milwaukee County. For example, many rural Wisconsin counties have high levels of poverty and unemployment or underemployment, while even some affluent suburban counties have significant pockets of poverty.

Therefore, while some policy changes might make sense at the zip code level (for example, increasing the availability of public transit in a particular zip code), many other policy-level interventions may be more effective at the state or federal level (for example, expanding the earned income tax credit (EITC), which would support health by helping lift all working poor families out of poverty, regardless of the zip code of the residence).

More specifically, since income and educational attainment are so highly correlated, evidence-based interventions to improve circumstances in *either* policy area (either income-related such as expanded EITC, living wage and transitional jobs, or education-related such as Head Start, universal pre-K and high-school retention programs) are likely to improve life expectancy.¹⁵ Other policy areas with evidence-based policy solutions that would improve health outcomes include employment, community safety, family and social support, criminal justice, built environment, housing and transit, among others.¹⁶

Health care practitioners and health care systems cannot expect improved population-level health outcomes (including life expectancy) if they focus solely on the provision of health care and do not more strongly involve themselves in social and policy-level activities necessary to improve the conditions for healthy, long, productive lives. Multiple authors¹⁷⁻¹⁸ and professional organizations (eg, American Academy of Pediatrics)¹⁹ have underscored the need to positively influence socioeconomic conditions while still providing accessible high-quality health care.

In their 2014 commentary, Swain et al provide detailed recommendations for concrete actions that health care professionals and others can and should take.¹⁴ Their recommendations include: 1) screening patients during clinical encounters for socioeconomic issues like access to basic needs (eg, food, employment, benefits, education); 2) coordinating services for individual patients by partnering with social workers, health advocates, community health workers and similar professionals to connect patients with the basic resources they need; 3) advocating for prohealth social and economic policies to help decision-makers understand the outsized impact that social and economic policies can have on a person's ability to be healthy; 4) working collectively with medical and health professional groups to address social determinants of health; and 5) being persistent, as policy change is often a gradual process.¹⁴

CONCLUSIONS

Life expectancy at birth varies greatly across zip codes in Milwaukee County. Overall, there was a 12-year difference in the life expectancy of children born into

zip codes with the lowest and highest life expectancy within the county. These intracounty differences greatly exceed the differences between Wisconsin counties overall, and they are strongly correlated with differences in social and economic factors across zip codes. To improve health outcomes such as life expectancy, health care practitioners and health care systems must become more involved in various activities at the individual level and at the policy level to improve the social and economic conditions necessary for their patients to live healthier and longer lives.

Patient-Friendly Recap

- How long people can expect to live can be dramatically different depending on where they reside at birth.
- The authors compared data on life expectancy at birth among zip codes within one urban county (Milwaukee, Wisconsin) and found stark differences that were strongly associated with social and economic factors.
- These factors likely drive other health disparities, not only urban but rural areas as well.
- Health practitioners may help reduce these disparities by seeking ways to improve social and economic conditions, thereby allowing their patients to live healthier, longer lives.

Conflicts of Interest

None.

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