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The Illinois Institute for Rural Affairs (IIRA) works to improve the quality of life for rural residents by partnering with public and private agencies on local development and enhancement efforts.

Western Illinois University

# Physical Activity of Illinoisans in the Metro and the Nonmetro

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## Abstract

This research shows that more nonmetro Illinoisans are physically inactive compared to their metro counterparts. Data analysis reveals that 80% of nonmetro residents are either overweight (Body-Mass Index more than 25, but less than 30) or obese (Body-Mass Index greater than or equal to 30). Logistic analysis of physical activity with various predictors suggests that daily intake of fruits contributes positively to the log odds of exercising.

## Introduction

The IIRA has been tasked to quantify and communicate the state's progress towards critical goals such as education and health. This paper focuses on a salient risk factor for public health and wellbeing, physical inactivity[2]. Although most children are physically active, the rate of physical activity (PA) drops as people age[3].

What proportion of Illinoisans engage in PA? Does the level of physical activity differ between the metro and the nonmetro residents? What are the correlates of PA? This paper addresses these and other related questions.

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[2] The US government's Healthy People 2030 lists physical activity as a leading indicator of preventive health behavior; see https://health.gov/healthypeople/objectives-and-data/browse-objectives/physical-activity.

[3] See, Caspersen, C. J., Pereira, M. A., & Curran, K. M. (2000). Changes in physical activity patterns in the United States, by sex and cross-sectional age. *Medicine & Science in Sports & Exercise*, *32*(9), 1601-1609.

## Conceptual Framework

Correlates of PA include both situational and individual factors; for example, lack of access to PA opportunities in the community and lack of motivation to engage in an active lifestyle. The law of effect predicts strengthened response to PA because of its positive impacts on health[4]. However, the aftereffects of PA may become a conditioned inhibitor.

To elaborate, consider the construct 'healthy living', defined as both physical and mental health[5]. As a construct, it has both antecedents and consequences; for example, eating green vegetables and PA would be the antecedents for healthy living and absence or reduced risk of disease would be a consequence (Figure 1).

**Figure 1: Healthy Living, antecedents and Consequences**

| Input Variables (Antecedents) | Construct | Output Variables (Consequence or Response) |
|---|---|---|
| PA<br>Eating vegetables<br>Eating fruits<br>Mental health (stress, depression, etc) | Healthy Living | Reduced risk of disease<br>Lengthened lifespan<br>Monetary benefits (savings) |

From a behavioral perspective, the response of PA, energy spent on exercise, may generate aversive drive, fatigue. Stopping to acquire the response would be reinforced by the reduction in fatigue. Thus, PA could be extinguished[6].

In summary, for some, PA could be associated with positive punishment. In the following pages we explore the exercising behavior of Illinoisans using survey data from the Center for Disease Control.

[4] Law of effect suggests that of several responses to the same situation, those which are closely followed by satisfaction to the organism will, other things being equal, be more firmly connected with the situation. Thorndike, E. (1898). Animal Intelligence, *Nature*, August 25, 58(1504), 390.

[5] https://www.cdc.gov/hrqol/index.htm.

[6] This reasoning is based on the equation: E = (H x D) – (Inhibitory factors such as fatigue), where E = net response strength, H = habit and D= drive; see Athiyaman, A. (2011). Marketing a university-affiliated applied research center: An application involving Hull-Spence behavioral theory. *Academy of Marketing Studies Journal*, 15(2), 107-126.

## Methodology

Microdata on Illinoisans' health behavior were obtained from the Behavioral Risk Factor Surveillance System, 2021[7]. The survey polled 438,693 individuals in the nation; Illinois had 3,210 respondents, weighted equivalent of 9,964,223 respondents, of which 487,550 respondents were from the nonmetro. Table 1 lists the variables used in the paper.

**Table 1: Variable Definitions**

| Variable | Definition |
|---|---|
| TOTINDA | Adults who reported doing PA during the past 30 days. |
| GENHLTH | General health, measured on a 1-5 scale; value labels: 1 = Excellent; 5 = Poor. |
| RACEGR3 | Race / ethnicity category; value labels: 1 = White; 2 = Black; 3 = Other; 4 = Hispanic. |
| GENDER | Respondent's gender; value labels: 1 = Male; 2 = Female. |
| AGE | Age category; value labels: 1 = 18-24; 2 = 25-34; 3 = 35-44; 4 = 45-54; 5 = 55-64; 6 = 65 or older. |
| WEIGHT2 | Respondent's weight without shoes; actual values. |
| EDUCAG | Level of education completed; value labels: 1 = LT high school; 2 = graduated high school; 3 = graduated from college. |
| BMICAT | Respondent's body-mass index; value labels: 1 = LT 18; 2 = 18-24; 3 = 25-29; 4 = 30 or more. |
| FRUIT1 | Total fruits consumed per day. |
| FRUTLT1A | Consumed fruit 1 or more times per day. |
| VEGE1 | Number of vegetables consumed per day. |
| MENTAL | How many days during the past 30 days you experienced stress, depression, or problems with emotions. |
| INCOME | Income categories; value labels: 1 = LT$15,000; 2 = 15k-LT25k; 3 = 25K-LT35k; 4 = 35k-LT50k; 5 = 50k-LT100k; 6 = 100k-LT200k; 7 = 200k or more. |

[7] https://www.cdc.gov/brfss/about/index.htm.

Data analysis involved crosstabulations of variables, variance analysis, group comparison *t* Test, and logit analysis. Since the research was exploratory in nature, the level of rejection for hypothesis testing, alpha, was set at 10%.

## Findings

The demographic composition of the population is different for the regions; a typical nonmetro resident is older and less educated than the average metro resident (Table 2). Since age is a predictor of PA, it is probable that more of the nonmetro residents will be physically inactive. This prediction is supported by data in Table 3; more than one third of the nonmetro residents are physically inactive, compared to approximately one fourth of the metro residents who are physically inactive.

**Table 2: Demographics of the Regions**

(i) Gender Composition

| Gender | Metro | Nonmetro |
|---|---|---|
| Female | 51% | 50% |
| Male | 49% | 50% |
| **N** | 9,476,673 | 487,550 |

**Note**: $\chi^2 = 214$; $p < 0.05$

(ii) Race

| Race | Metro | Nonmetro |
|---|---|---|
| White | 62% | 91% |
| Black | 14% | 4% |
| Hispanic | 17% | 2% |
| Other | 7% | 3% |
| **N** | 9,193,274 | 468,354 |

**Note**: $\chi^2 = 173{,}607$; $p < 0.05$

(iii) Age

| Age Group | Metro | Nonmetro |
|---|---|---|
| 18-24 | 12% | 5% |
| 25-34 | 17% | 16% |
| 35-44 | 17% | 12% |
| 45-54 | 16% | 14% |
| 55-64 | 16% | 23% |
| 65 and Above | 22% | 30% |
| **N** | 9,476,673 | 487,550 |

**Note**: $\chi^2 = 54{,}334$; $p < 0.05$

(iv) Education

| Level of Education | Metro | Nonmetro |
|---|---|---|
| Less than High School | 11% | 9% |
| High School Graduate | 56% | 74% |
| College Degree | 34% | 17% |
| **N** | 9,347,122 | 487,550 |

**Note**: $\chi^2$ = 69,330; $p < 0.05$

(v) Household Income

| Income Category | Metro | Nonmetro |
|---|---|---|
| Less than $15,000 | 5% | 7% |
| $15,000 – LT $25,000 | 9% | 14% |
| $25,000 – LT $35,000 | 13% | 7% |
| $35,000 – LT $50,000 | 14% | 18% |
| $50,000 – LT $100,000 | 29% | 38% |
| $100,000 – LT $200,000 | 23% | 11% |
| $200,000 or more | 7% | 5% |
| **N** | 6,863,867 | 349,433 |

**Note**: $\chi^2$ = 56,339; $p < 0.05$

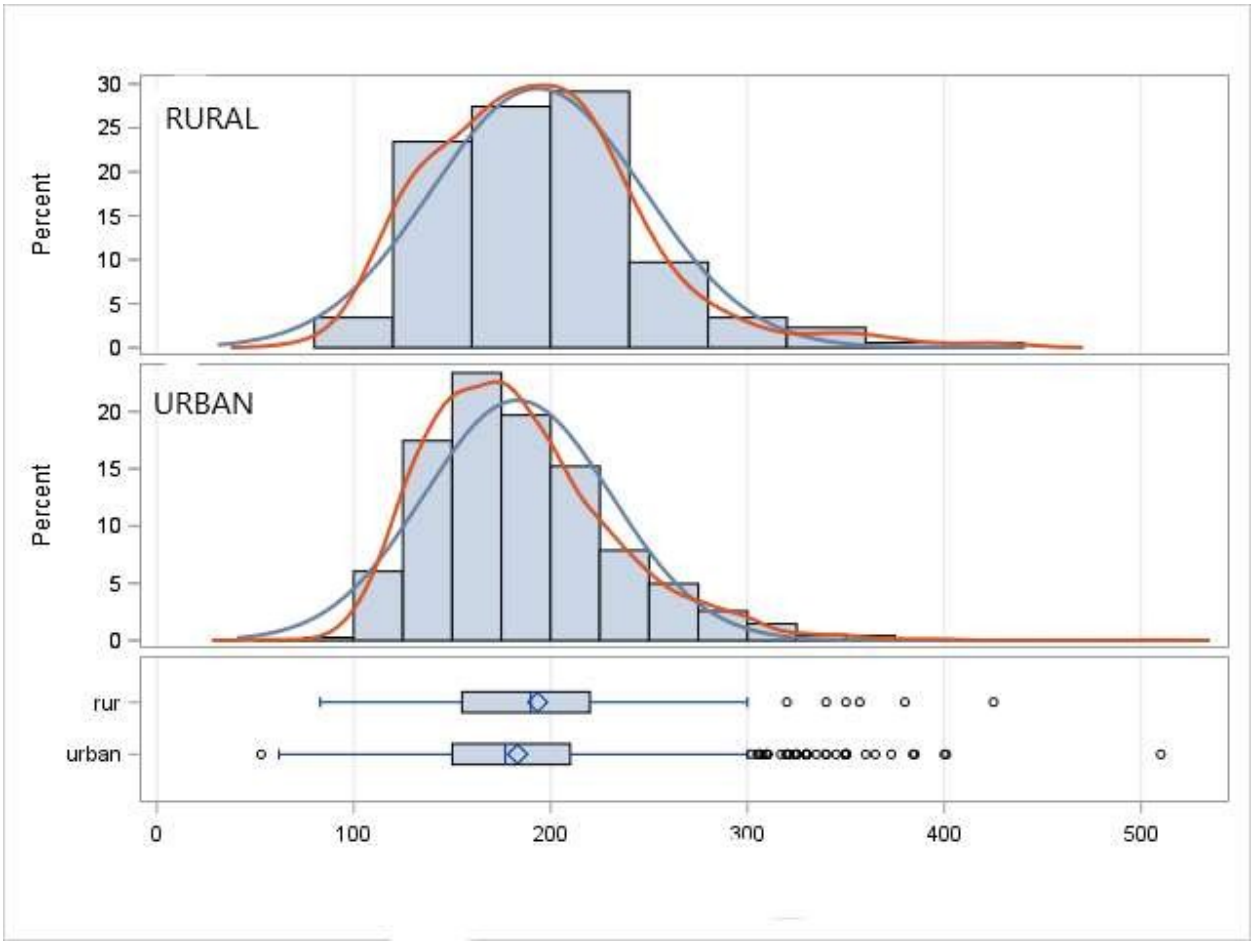
**Table 3: Physical Activity in the Last 30 Days**

| Physical Activity | Metro | Nonmetro |
|---|---|---|
| Yes | 73% | 63% |
| No | 27% | 37% |
| **N** | 9,456,119 | 486,228 |

**Note**: $\chi^2$ = 22,719; $p < 0.05$

The higher proportion of physically inactive in the nonmetro has resulted in a higher average bodyweight for the rural population (Figure 2). In addition, 80% of the nonmetro residents are either obese or overweight, as measured by their body-mass index. In general, slightly more than two out of three Illinoisans are either obese or overweight (Table 4).

**Figure 2: Average Bodyweight: Metro versus Nonmetro Residents**




**Note**: $\mu_{Nonmetro}$ = 193.4pounds, $\mu_{Metro}$ = 183.2pounds; $\sigma_{nonmetro}$ = 54; $\sigma_{Metro}$ =48; $t$ = 2.73; $p < .05$

**Table 4: Body-Mass Index**

| Category | Metro | Nonmetro |
|---|---|---|
| Underweight | 2% | 1% |
| Normal Weight | 30% | 18% |
| Overweight | 35% | 33% |
| Obese | 33% | 47% |
| **N** | 8,188,218 | 430,523 |

**Note**: $\chi^2$ = 42,814; $p < 0.05$

To assess the likelihood of one engaging in PA, a logistic regression model was calibrated with five predictors: general health of the respondent, number of vegetables consumed per day, number of fruits consumed daily, metro / nonmetro location, and race of the respondent. Table 5 shows the results of this exercise; Appendix 1 provides summary statistics for the model.

**Table 5: Maximum Likelihood Parameter Estimates**

| Variable | Estimate | Std. Error | Wald Chi-Square | Prob. |
|---|---|---|---|---|
| Intercept | 2.08 | .29 | 49.85 | <.0001 |
| General health | -.63 | .04 | 167.71 | <.0001 |
| No. of fruits consumed per day | .00174 | .000532 | 10.71 | 0.0011 |
| No. of vegetables consumed daily | .000834 | .000477 | 3.06 | 0.08 |
| Region: 1 = metro and 2 = nonmetro | .31 | .18 | 2.76 | 0.09 |
| Race | Insignificant | | | |

For every one unit change of general health to the worse, the log odds of exercising (versus not exercising) decreases by .63; increases in daily consumption of fruits and vegetables contribute positively to the log odds of exercising. Also, residing in the metro increases the log odds of exercising.

The odds ratio is the exponentiated coefficient, parameter estimate. This ratio suggests that, for instance, for a one unit increase in number of fruits consumed, the probability of exercising increases by 50%.

## Summary and Conclusion

This paper addresses questions about Illinoisans' physical activity. Results of empirical analysis of BRFSS, 2021 data show that:

(i) 27% of Illinoisans do not exercise;

(ii) more than one third of the nonmetro residents are physically inactive, 37%; the proportion of physically inactive in the metro is lower than the nonmetro, 0.27;

(iii) 80% of the nonmetro residents are either obese or overweight, and

(iv) for every one unit change of general health to the worse, the log odds of exercising (versus not exercising) decreases by .61.

This research has highlighted some of the salient determinants of health behavior; lack of data on PA maintenance prevents us from exploring barriers to PA maintenance, both individual and contextual factors, as discussed in the theory section of the paper.

## Appendix 1: Summary Statistics for the Qualitative, Maximum Likelihood, Logistic Model

| Model Fit Statistics | | |
|---|---|---|
| Criterion | Intercept Only | Intercept and Covariates |
| AIC | 2936.032 | 2715.949 |
| SC | 2941.910 | 2762.968 |
| -2 Log L | 2934.032 | 2699.949 |

$\ell(c) = 2934.032$: This model assumes that only $\beta_0$ is relevant. Another assumption of the model is that the probability of choosing a response is equal to the observed frequencies; 0.73 for the "yes" response.

| Testing Global Null Hypothesis: BETA=0 | | | |
|---|---|---|---|
| Test | Chi-Square | DF | Pr > ChiSq |
| Likelihood Ratio | 234.0833 | 7 | <.0001 |
| Score | 212.7988 | 7 | <.0001 |
| Wald | 204.8188 | 7 | <.0001 |

$\ell(\beta) = \sim 234$: This is the value of the maximum likelihood function at its maximum; this statistic is used to test the null hypothesis that all parameters are zero. It is distributed as $\chi^2$ with 7 degrees of freedom. In our case, the null hypothesis can be rejected at the 0.0001 level of significance.

$\rho^2 = 0.69$: It is similar to $R^2$ in regression; it is a goodness-of-fit measure.