

Appendix B

Special Report: Investigation of Body Mass Index

**HEALTH NEEDS, PREFERENCES, and UTILIZATION
ASSESSMENT REPORT
For
ISABELLA, GRATIOT, CLARE, and GLADWIN COUNTY
MICHIGAN**

SPECIAL REPORT: INVESTIGATION OF BODY MASS INDEX

June 2003

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*A Research Study by Central Michigan University
The Herbert H. and Grace A. Dow College of Health Professions
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Health Needs, Preferences, and Utilization Assessment Survey Report 2003

Body Mass Index Investigation

Snapshot

Survey Demographics:

- There were 29,250 surveys distributed to Isabella, Gratiot, Clare and Gladwin County and 4,032 (13.78%) returned. Of 4,032 surveys returned, 3,506 (11.99%) were analyzed;
- 68.7% of the respondents were female;
- 36.9% of the respondents were between 40 and 59 years old;
- Over 91% of the respondents identified white as their ethnicity;

Body Mass Index (BMI): Overweight and Obesity

- Over 60% of residents in Isabella, Gratiot, Clare, and Gladwin County are considered either overweight (BMI 25.0-29.9) or obese (BMI 30.0+);
- Women tend to maintain a more desirable weight (BMI 20.0-24.9) than do men;
- More men (78.1%) are considered either overweight or obese than women (64.9%);
- More women (35.3%) are considered obese than men (25.9%);
- People who are between 40-79 years old have a higher tendency to be either overweight or obese;
- Women in Isabella County tend to maintain a more desirable weight than other counties while women in Gladwin County have a higher tendency to be obese;
- Residents with a bachelor's degree or higher have a higher tendency to maintain a more desirable weight than residents with less education;
- Residents with family incomes under \$50,000 a year tend to weigh more than residents with family incomes at or above \$50,000 a year.

General Survey Information

Table 1. County Population and Survey Response

County	County Population (2000)	Surveys Distributed	Surveys Returned	Surveys Analyzed
Isabella	63,351	10,250	1428(13.93%)	1,005 (9.81%)
Gratiot	42,285	8,000	1054 (13.18%)	1,014 (12.68%)
Clare	31,252	6,000	883 (14.72%)	848 (14.13%)
Gladwin	26,023	5,000	667 (13.34%)	639 (12.78%)
Total	162,911	29,250	4,032 (13.78%)	3,506 (11.99%)

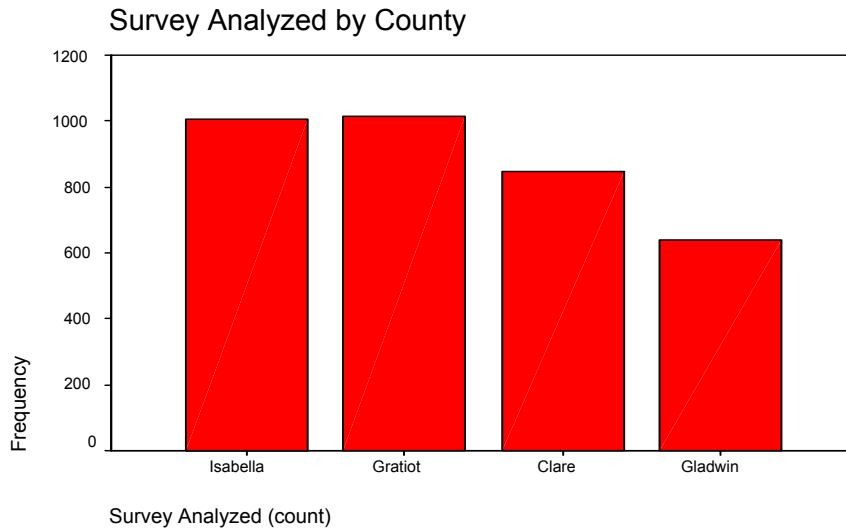


Figure 1. Surveys Analyzed (count)

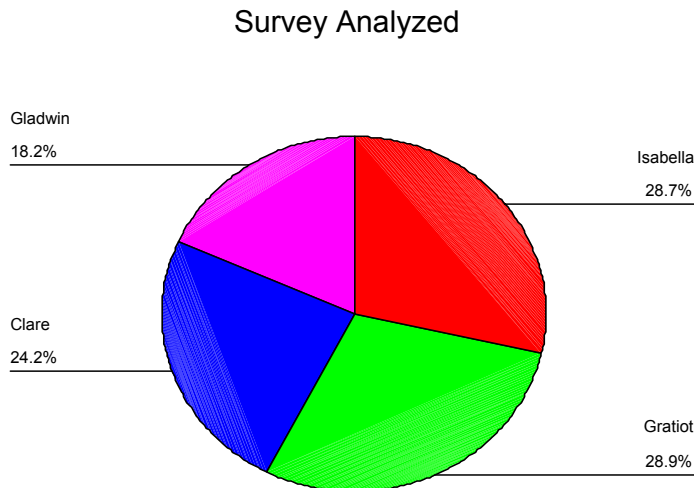


Figure 2. Surveys Analyzed (percentile)

Table 2. Survey Respondents by Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	900	25.7	27.2	27.2
	Female	2407	68.7	72.8	100.0
	Total	3307	94.3	100.0	
Missing	System	199	5.7		
Total		3506	100.0		

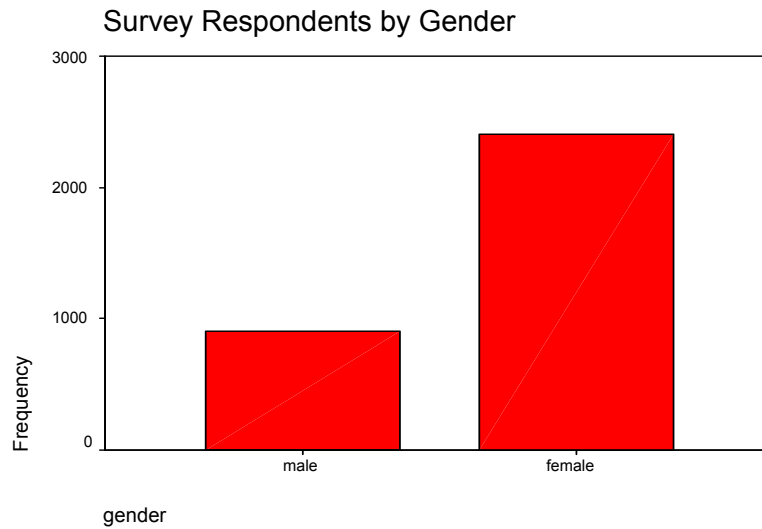


Figure 3. Survey Respondents by Gender (count)

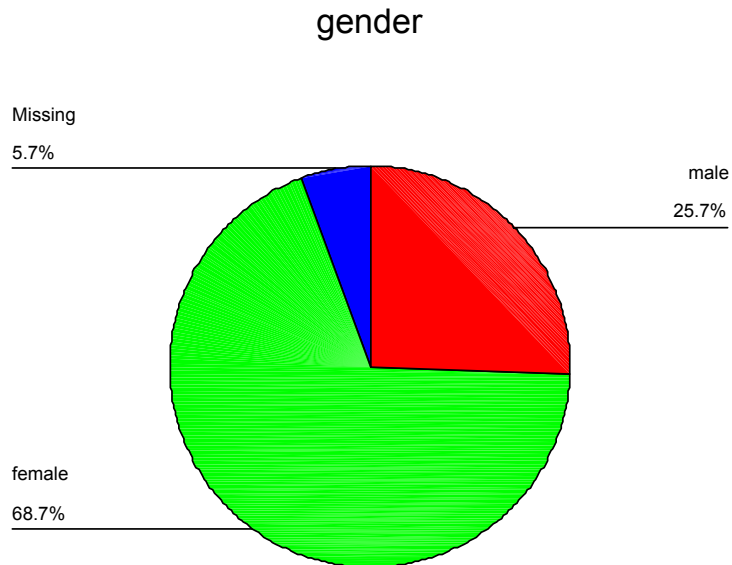


Figure 4. Survey Respondents by Gender (percentile)

Table 3. Survey Respondents by Ethnicity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Black	12	.3	.4	.4
	Hispanic	14	.4	.4	.8
	White	3208	91.5	97.0	97.8
	Asian	8	.2	.2	98.0
	Native American	38	1.1	1.1	99.2
	Other	28	.8	.8	100.0
Total		3308	94.4	100.0	
Missing	System	198	5.6		
Total		3506	100.0		

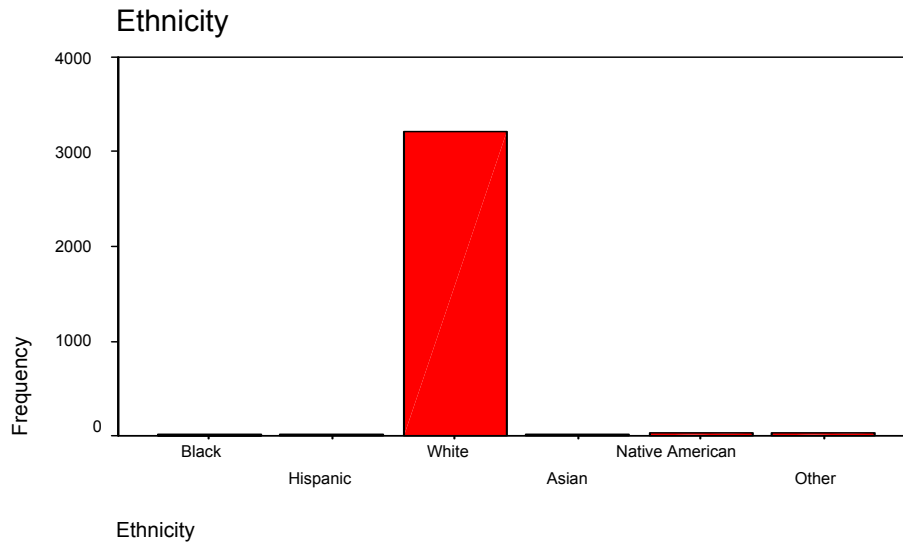


Figure 5. Survey Respondents by Ethnicity (count)

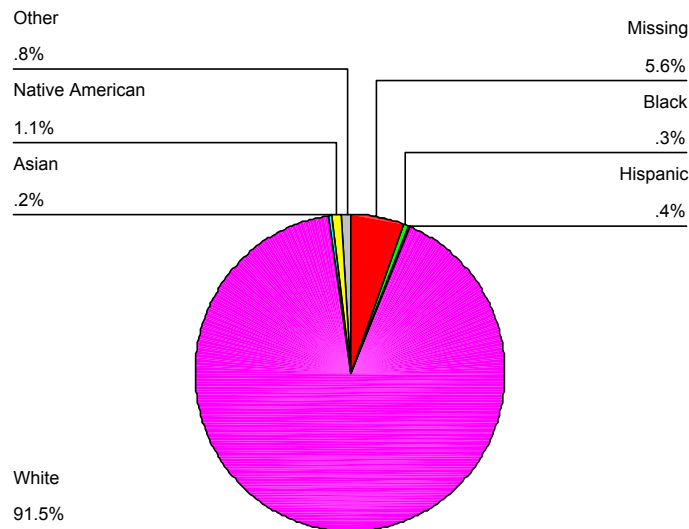


Figure 6. Survey Respondents by Ethnicity (percentile)

Table 4. Survey Respondents by Education Level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	8th grade or less	59	1.7	1.8	1.8
	Some high school	158	4.5	4.9	6.7
	High school graduate	990	28.2	30.5	37.2
	Some college	1169	33.3	36.1	73.3
	Bachelor's degree	524	14.9	16.2	89.5
	Master's degree	282	8.0	8.7	98.1
	Doctoral degree	60	1.7	1.9	100.0
	Total	3242	92.5	100.0	
Missing	System	264	7.5		
Total		3506	100.0		

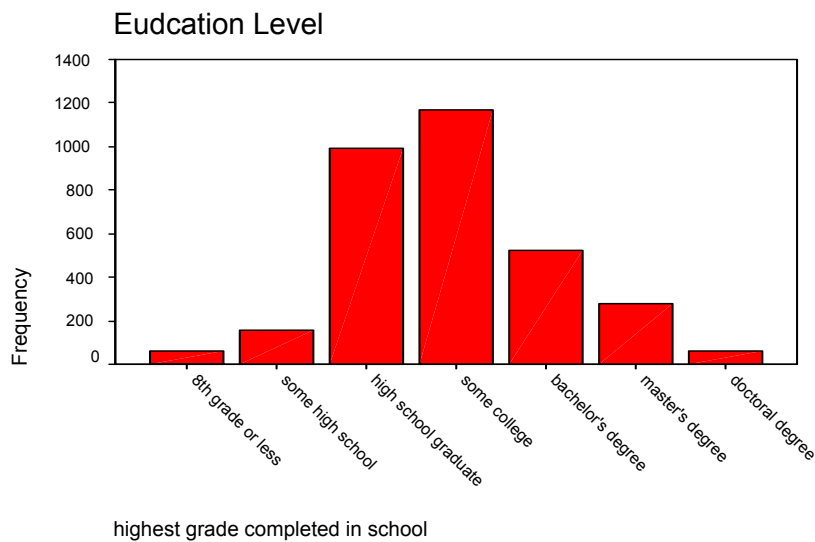


Figure 7. Survey Respondents by Education Level (count)

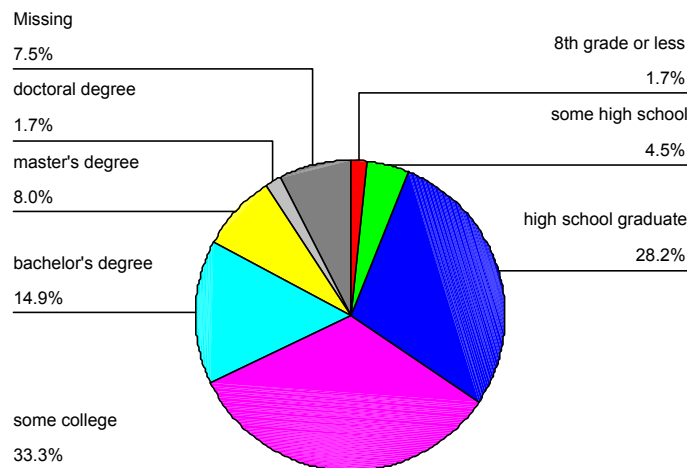


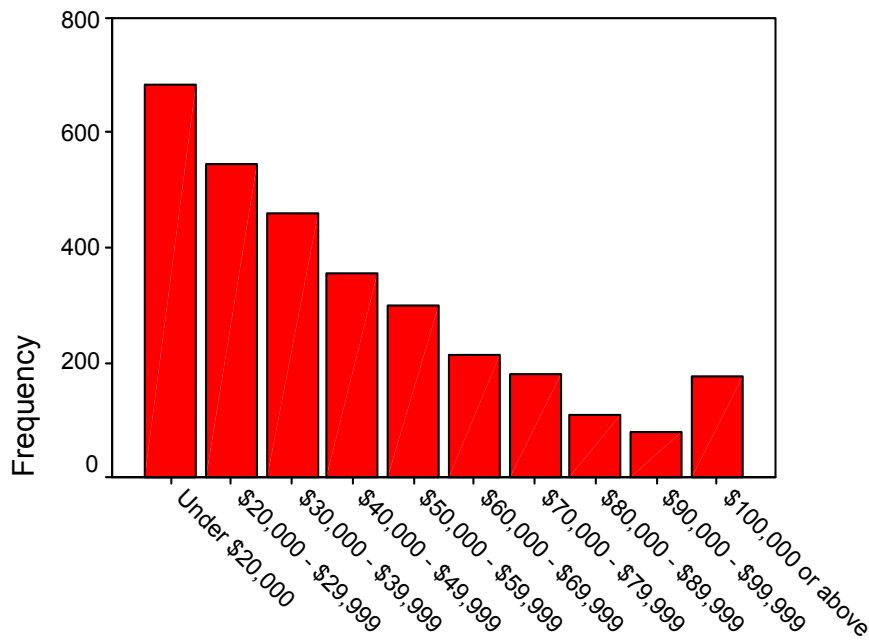
Figure 8. Survey Respondents by Education Level (percentile)

Disclaimer: Recommendations and interventions are at the discretion of the reader.

Table 5. Respondents by Family/Household Income

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Under \$20,000	685	19.5	22.1	22.1
	\$20,000 - \$29,999	544	15.5	17.6	39.7
	\$30,000 - \$39,999	459	13.1	14.8	54.5
	\$40,000 - \$49,999	354	10.1	11.4	66.0
	\$50,000 - \$59,999	300	8.6	9.7	75.7
	\$60,000 - \$69,999	213	6.1	6.9	82.6
	\$70,000 - \$79,999	178	5.1	5.8	88.3
	\$80,000 - \$89,999	107	3.1	3.5	91.8
	\$90,000 - \$99,999	80	2.3	2.6	94.3
	\$100,000 or above	175	5.0	5.7	100.0
Total		3095	88.3	100.0	
Missing	System	411	11.7		
Total		3506	100.0		

Family/Household Income Last Year



family/household income last year

Figure 9. Respondents by Family/Household Income

Table 6. Survey Respondents by Age Groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 - 19 Years	135	3.9	4.1	4.1
	20 to 39 Years	792	22.6	23.9	28.0
	40 to 59 Years	1293	36.9	39.1	67.0
	60 to 79 Years	960	27.4	29.0	96.0
	80 Years and Above	131	3.7	4.0	100.0
	Total	3311	94.4	100.0	
Missing	System	195	5.6		
Total		3506	100.0		

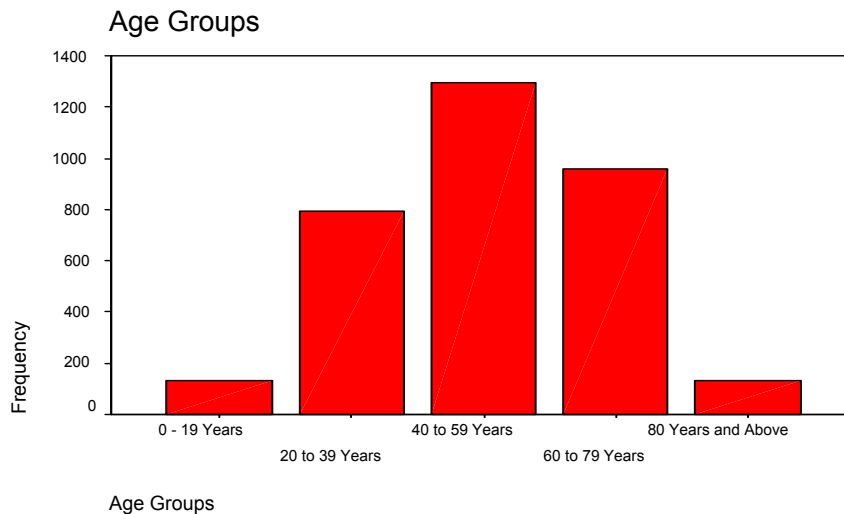


Figure 10. Survey Respondents by Age Groups (count)

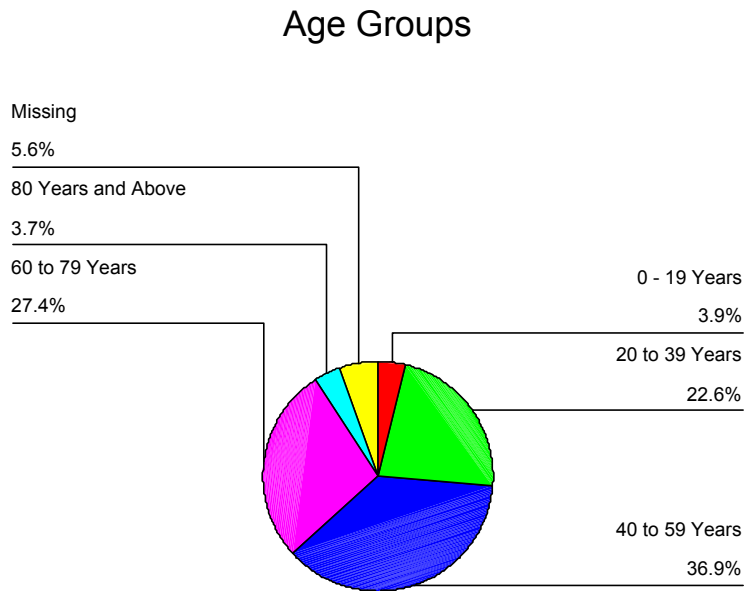


Figure 11. Survey Respondents by Age Groups (percentile)

Table 7. Age of Respondents by County

County		Age Groups					Total
		0 - 19 Years	20 to 39 Years	40 to 59 Years	60 to 79 Years	80 Years and Above	
Isabella	Count	14	320	340	175	25	874
	% Within County	1.6%	36.6%	38.9%	20.0%	2.9%	100.0%
Gratiot	Count	51	209	407	279	47	993
	% Within County	5.1%	21.0%	41.0%	28.1%	4.7%	100.0%
Clare	Count	15	169	333	290	30	837
	% Within County	1.8%	20.2%	39.8%	34.6%	3.6%	100.0%
Gladwin	Count	55	94	213	216	29	607
	% Within County	9.1%	15.5%	35.1%	35.6%	4.8%	100.0%
Total	Count	135	792	1293	960	131	3311
	% Within County	4.1%	23.9%	39.1%	29.0%	4.0%	100.0%

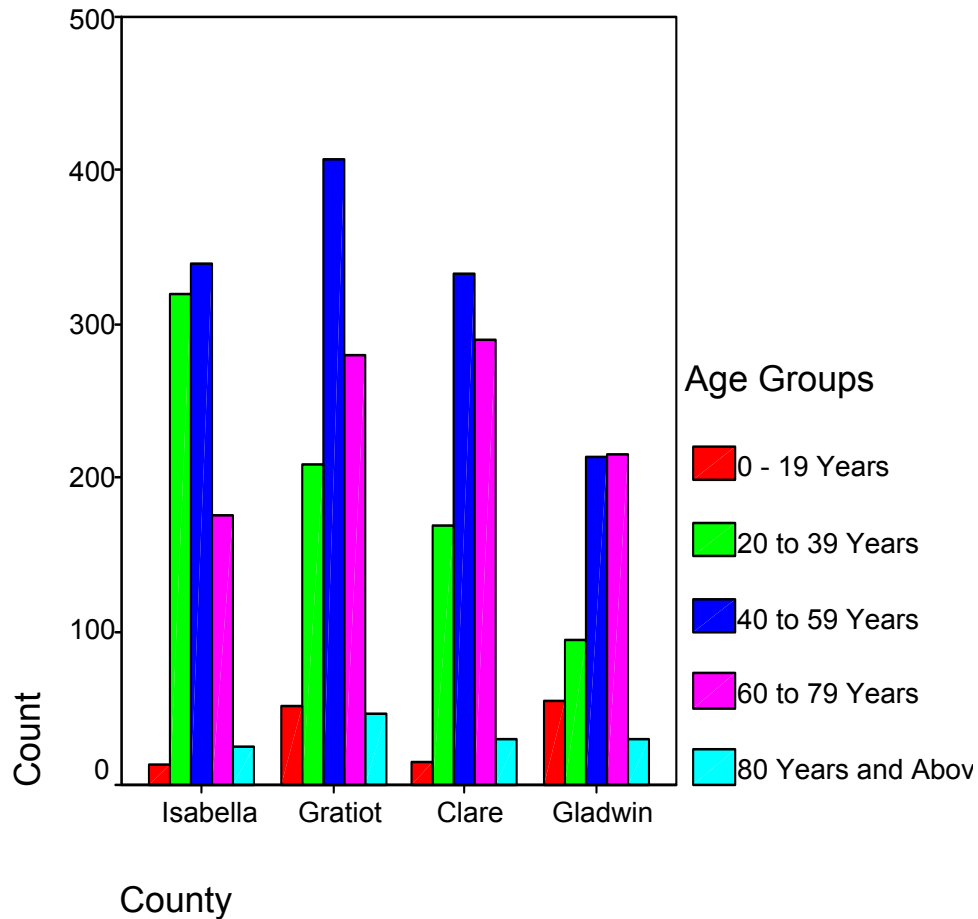


Figure 12. Age of Respondents by County (count)

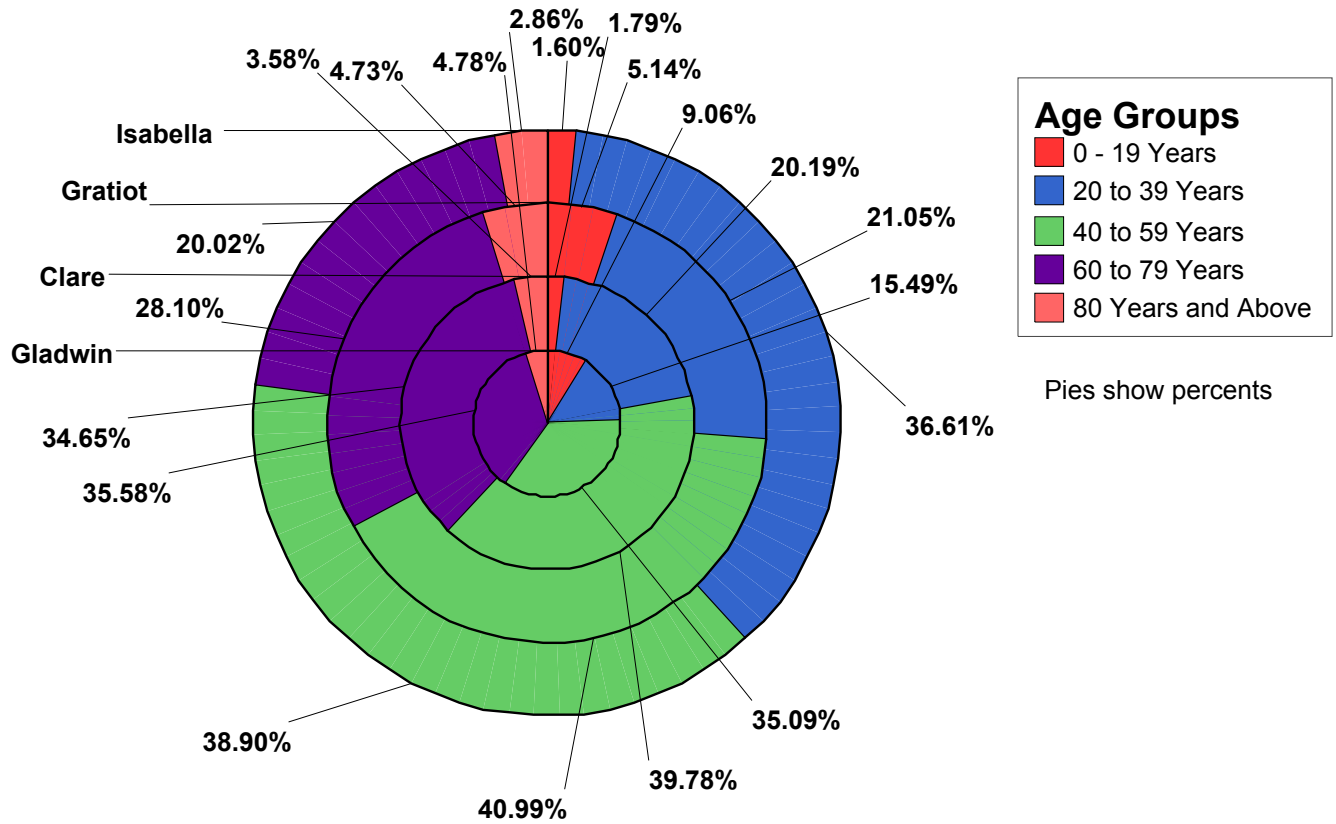


Figure 13. Age of Respondents by County (percentile)

Obesity

Obesity is a medical condition concerning storage of excess body fat. Fat is critical for good health, but too much fat accumulation in the body is associated with a variety of health problems. Individuals who are overweight or obese face a greater risk of developing diabetes mellitus, hypertension, coronary heart disease, stroke, arthritis, and some forms of cancer.

Obesity and Disease

Almost 70 percent of heart disease cases in the United States are linked to excess body fat. Obese people are more than twice as likely to develop hypertension, a leading factor in heart disease.

Obese women are at nearly twice the risk for developing breast cancer. Obese people have a 42 percent higher chance of developing colorectal cancer.

Almost 80 percent of patients with Type 2 diabetes mellitus, known as non-insulin-dependent diabetes mellitus, are obese. Determination of obesity is based on calculation of body mass index (BMI).

Body Mass Index

In order to determine desirable body weight, the body mass index (BMI) is commonly used, which is a measure of an adult's weight in relation to height. BMI is calculated metrically, which is weight divided by height squared (kg/m^2). A BMI of 20.0 to 24.9 is desirable for most adults. Individuals with BMI of 25.0 to 29.9 are considered overweight and people with a BMI of 30 or above are considered obese. An individual who is 5 feet 8 inches tall has a BMI of 25.0 when his/her weight is 165 pounds.

Table 8. Body Mass Index Groups (Isabella, Gratiot, Clare, Gladwin)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Underweight	147	4.2	4.8	4.8
	Desirable Weight	821	23.4	26.7	31.4
	Overweight	1042	29.7	33.8	65.3
	Obese	1070	30.5	34.7	100.0
	Total	3080	87.8	100.0	
Missing	System	426	12.2		
Total		3506	100.0		

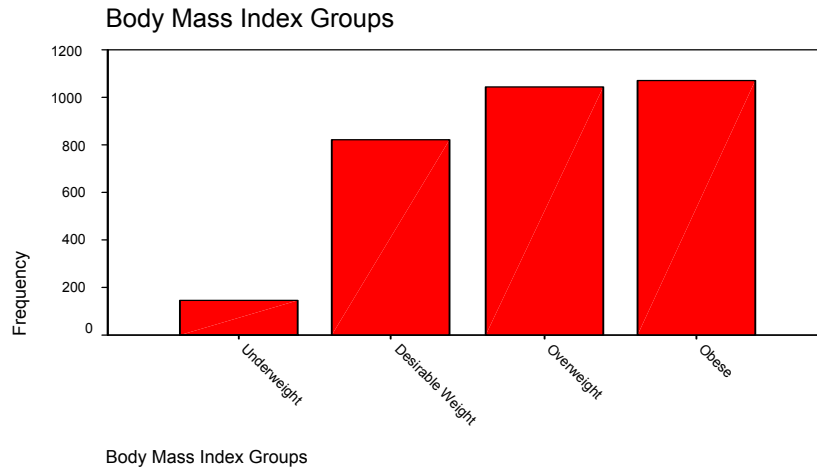


Figure 14. Respondents' Body Mass Index (count)

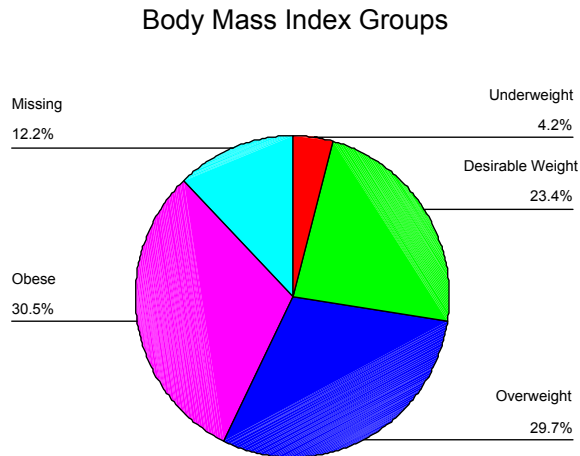


Figure 15. Respondents' Body Mass Index (percentile)

Of the surveys analyzed, 23.4% of the respondents belong to the desirable weight BMI group, while over 60% of the respondents are in the categories of overweight or obese.

Body Mass Index and Demographic Factors.

The following tables illustrate body mass index (BMI) of the respondents along with important demographic factors. Significant findings, using a χ^2 inferential test of significance, will be shown if significance is at or below a .05 level of probability; if χ^2 is not shown, then the finding was not significant ($p > .05$). If χ^2 is significant, then there is a significant association between the BMI and the demographic factor (such as gender or age group).

Table 9. Body Mass Index (BMI) and Gender

		Body Mass Index Groups				Total	
		Underweight (below 20)	Desirable Weight (20.0-24.9)	Overweight (25.0-29.9)	Obese (30.0 and above)		
Gender	Male	Count	19	161	371	272	823
		% Within gender	2.3%	19.6%	45.1%	33.0%	100.0%
		% Within BMI Group	13.1%	19.9%	36.2%	25.9%	27.1%
		% of Total	.6%	5.3%	12.2%	9.0%	27.1%
	Female	Count	126	650	654	779	2209
		% Within gender	5.7%	29.4%	29.6%	35.3%	100.0%
		% Within BMI Group	86.9%	80.1%	63.8%	74.1%	72.9%
		% of Total	4.2%	21.4%	21.6%	25.7%	72.9%
Total	Count	145	811	1025	1051	3032	
	% Within gender	4.8%	26.7%	33.8%	34.7%	100.0%	
	% Within BMI Group	100.0%	100.0%	100.0%	100.0%	100.0%	
	% of Total	4.8%	26.7%	33.8%	34.7%	100.0%	

There is a significant association between body mass index group and gender with $\chi^2 (3, n = 3,032) = 79.570, p = .000$ (2 tailed). More women (29.4%) are with a desirable weight (BMI of 20.0 to 24.9) than men (19.6%), but more women (35.3%) are considered obese (BMI of 30.0 and above) than men (33.0%). In these four counties, more men (78.1%) are considered either overweight or obese than women (64.9%). However, more women (35.3%) are obese than men (33.0%) when considering this category alone.

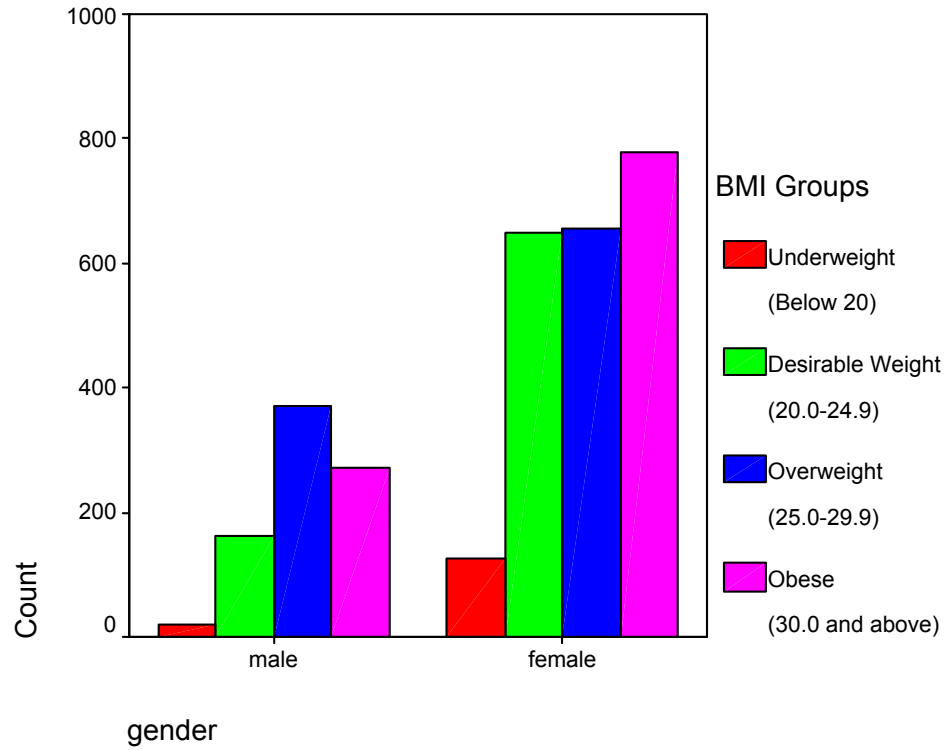


Figure 16. Body Mass Index and Gender (count)

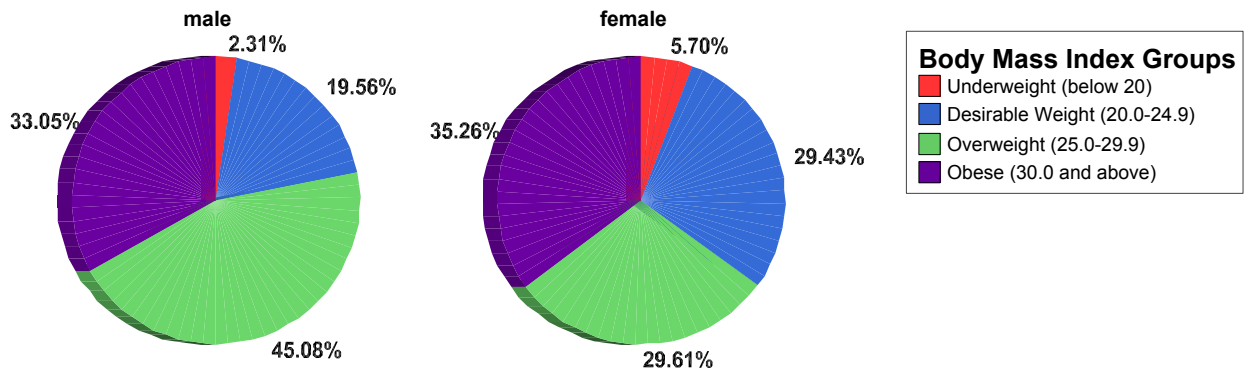


Figure 17. Body Mass Index Group and Gender (percentile)

Table 10. Body Mass Index and Age Groups

		Body Mass Index Groups				Total	
		Underweight (below 20.0)	Desirable weight (20.0-24.9)	Overweight (25.0-29.9)	Obese (30.0 and above)		
Age Groups	0 - 19 Years	Count	12	28	28	33	101
		% Within Age Groups	11.9%	27.7%	27.7%	32.7%	100.0%
		% Within BMI Groups	8.3%	3.5%	2.7%	3.1%	3.3%
		% of Total	.4%	.9%	.9%	1.1%	3.3%
	20 to 39 Years	Count	54	252	228	226	760
		% Within Age Groups	7.1%	33.2%	30.0%	29.7%	100.0%
		% Within BMI Groups	37.2%	31.1%	22.1%	21.4%	25.0%
		% of Total	1.8%	8.3%	7.5%	7.4%	25.0%
	40 to 59 Years	Count	45	315	381	470	1211
		% Within Age Groups	3.7%	26.0%	31.5%	38.8%	100.0%
		% Within BMI Groups	31.0%	38.9%	36.8%	44.5%	39.8%
		% of Total	1.5%	10.3%	12.5%	15.4%	39.8%
	60 to 79 Years	Count	24	172	360	309	865
		% Within Age Groups	2.8%	19.9%	41.6%	35.7%	100.0%
		% Within BMI Groups	16.6%	21.2%	34.8%	29.2%	28.4%
		% of Total	.8%	5.6%	11.8%	10.1%	28.4%
80 Years and Above	Count	10	43	37	19	109	
	% Within Age Groups	9.2%	39.4%	33.9%	17.4%	100.0%	
	% Within BMI Groups	6.9%	5.3%	3.6%	1.8%	3.6%	
	% of Total	.3%	1.4%	1.2%	.6%	3.6%	
Total	Count	145	810	1034	1057	3046	
	% Within Age Groups	4.8%	26.6%	33.9%	34.7%	100.0%	
	% Within BMI Groups	100.0%	100.0%	100.0%	100.0%	100.0%	
	% of Total	4.8%	26.6%	33.9%	34.7%	100.0%	

There is a significant association between body mass index group and age group with χ^2 (12, n = 3,046) = 110.753, p = .000 (2 tailed). Respondents who are between 40-79 years old have a higher tendency to be either overweight (BMI of 25.0-29.9) or obese (BMI of 30.0 and above).

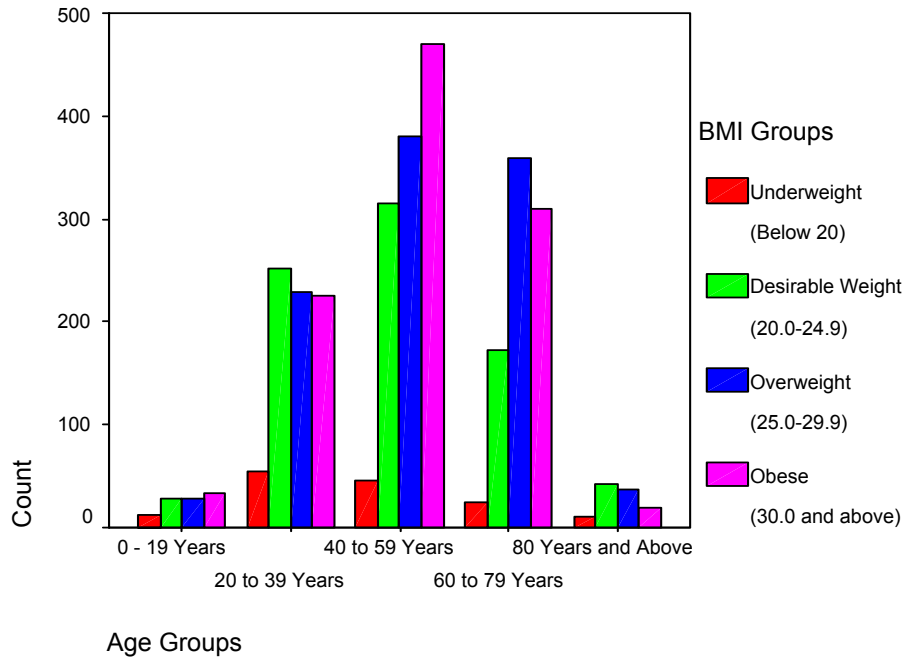


Figure 18. Body Mass Index and Age Groups

Table 11. Body Mass Index Groups and County

County	Isabella		Body Mass Index Groups				Total
			Underweight (below 20.0)	Desirable Weight (20.0-24.9)	Overweight (25.0-29.9)	Obese (30.0 and above)	
	Isabella	Count	45	261	275	243	824
		% Within County	5.5%	31.7%	33.4%	29.5%	100.0%
		% Within BMI Group	30.6%	31.8%	26.4%	22.7%	26.8%
		% of Total	1.5%	8.5%	8.9%	7.9%	26.8%
	Gratiot	Count	46	230	323	318	917
		% Within County	5.0%	25.1%	35.2%	34.7%	100.0%
		% Within BMI Group	31.3%	28.0%	31.0%	29.7%	29.8%
		% of Total	1.5%	7.5%	10.5%	10.3%	29.8%
	Clare	Count	28	197	271	291	787
		% Within County	3.6%	25.0%	34.4%	37.0%	100.0%
		% Within BMI Group	19.0%	24.0%	26.0%	27.2%	25.6%
		% Of Total	.9%	6.4%	8.8%	9.4%	25.6%
Gladwin	Count	28	133	173	218	552	
	% Within County	5.1%	24.1%	31.3%	39.5%	100.0%	
	% Within BMI Group	19.0%	16.2%	16.6%	20.4%	17.9%	
	% Of Total	.9%	4.3%	5.6%	7.1%	17.9%	
Total	Count	147	821	1042	1070	3080	
	% Within County	4.8%	26.7%	33.8%	34.7%	100.0%	
	% Within BMI Group	100.0%	100.0%	100.0%	100.0%	100.0%	
	% Of Total	4.8%	26.7%	33.8%	34.7%	100.0%	

Disclaimer: Recommendations and interventions are at the discretion of the reader.

There is a significant association between body mass index group and the surveyed county with $\chi^2 (9, n = 3,080) = 27.179, p = .001$ (2 tailed). Residents of Isabella County have a higher tendency to maintain a more desirable weight (BMI 20.0-24.9) than the other counties, and residents of Gladwin County tend have a higher tendency to be obese than the other counties.

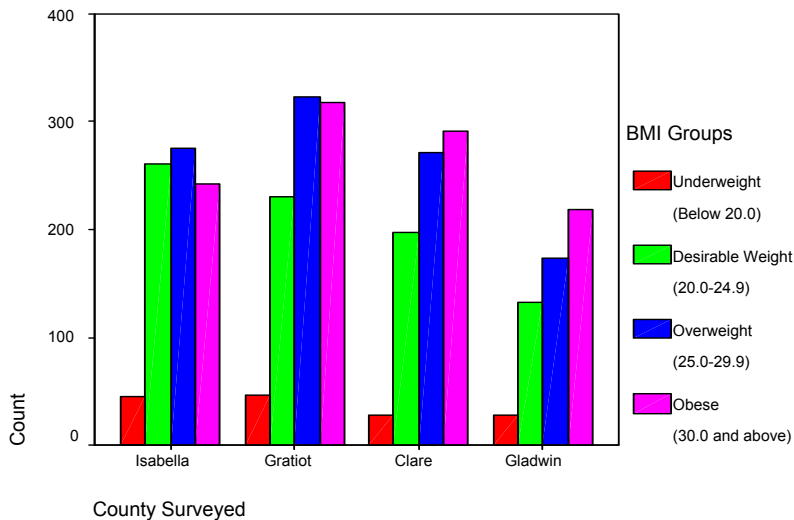


Figure 19. Body Mass Index and County (count)

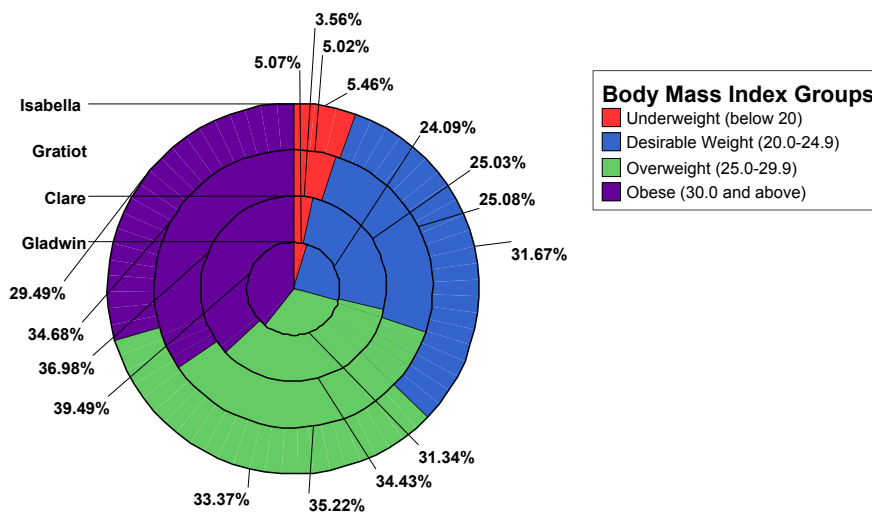


Figure 20. Body Mass Index and County (percentile)

Table 12. Body Mass Index and County controlling for Gender

Gender				Body Mass Index Groups				Total
				Under-weight (Below 20)	Desirable Weight (20-24.9)	Over-weight (25-29.9)	Obese (30 and above)	
Male	County	Isabella	Count	4	43	102	50	199
			% within County	2.0%	21.6%	51.3%	25.1%	100.0%
			% within BMI Group	21.1%	26.7%	27.5%	18.4%	24.2%
		% of Total	.5%	5.2%	12.4%	6.1%	24.2%	
		Gratiot	Count	5	46	102	84	237
			% within County	2.1%	19.4%	43.0%	35.4%	100.0%
			% within BMI Group	26.3%	28.6%	27.5%	30.9%	28.8%
		% of Total	.6%	5.6%	12.4%	10.2%	28.8%	
		Clare	Count	6	37	98	82	223
			% within County	2.7%	16.6%	43.9%	36.8%	100.0%
			% within BMI Group	31.6%	23.0%	26.4%	30.1%	27.1%
		% of Total	.7%	4.5%	11.9%	10.0%	27.1%	
	Gladwin	Count	4	35	69	56	164	
		% within County	2.4%	21.3%	42.1%	34.1%	100.0%	
		% within BMI Group	21.1%	21.7%	18.6%	20.6%	19.9%	
	% of Total	.5%	4.3%	8.4%	6.8%	19.9%		
	Total	Count	19	161	371	272	823	
		% within County	2.3%	19.6%	45.1%	33.0%	100.0%	
		% within BMI Group	100.0%	100.0%	100.0%	100.0%	100.0%	
		% of Total	2.3%	19.6%	45.1%	33.0%	100.0%	
Female	County	Isabella	Count	41	217	173	190	621
			% within County	6.6%	34.9%	27.9%	30.6%	100.0%
			% within BMI Group	32.5%	33.4%	26.5%	24.4%	28.1%
		% of Total	1.9%	9.8%	7.8%	8.6%	28.1%	
		Gratiot	Count	40	179	211	222	652
			% within County	6.1%	27.5%	32.4%	34.0%	100.0%
			% within BMI Group	31.7%	27.5%	32.3%	28.5%	29.5%
		% of Total	1.8%	8.1%	9.6%	10.0%	29.5%	
		Clare	Count	21	159	171	209	560
			% within County	3.8%	28.4%	30.5%	37.3%	100.0%
			% within BMI Group	16.7%	24.5%	26.1%	26.8%	25.4%
		% of Total	1.0%	7.2%	7.7%	9.5%	25.4%	
	Gladwin	Count	24	95	99	158	376	
		% within County	6.4%	25.3%	26.3%	42.0%	100.0%	
		% within BMI Group	19.0%	14.6%	15.1%	20.3%	17.0%	
	% of Total	1.1%	4.3%	4.5%	7.2%	17.0%		
	Total	Count	126	650	654	779	2209	
		% within County	5.7%	29.4%	29.6%	35.3%	100.0%	
		% within BMI Group	100.0%	100.0%	100.0%	100.0%	100.0%	
		% of Total	5.7%	29.4%	29.6%	35.3%	100.0%	

This result is significant within female with $\chi^2 (9, n = 2,309) = 28.336, p = .001$

(2 tailed). Women in Isabella County tend to maintain desirable weight while women in Gladwin County have a higher tendency to be obese.

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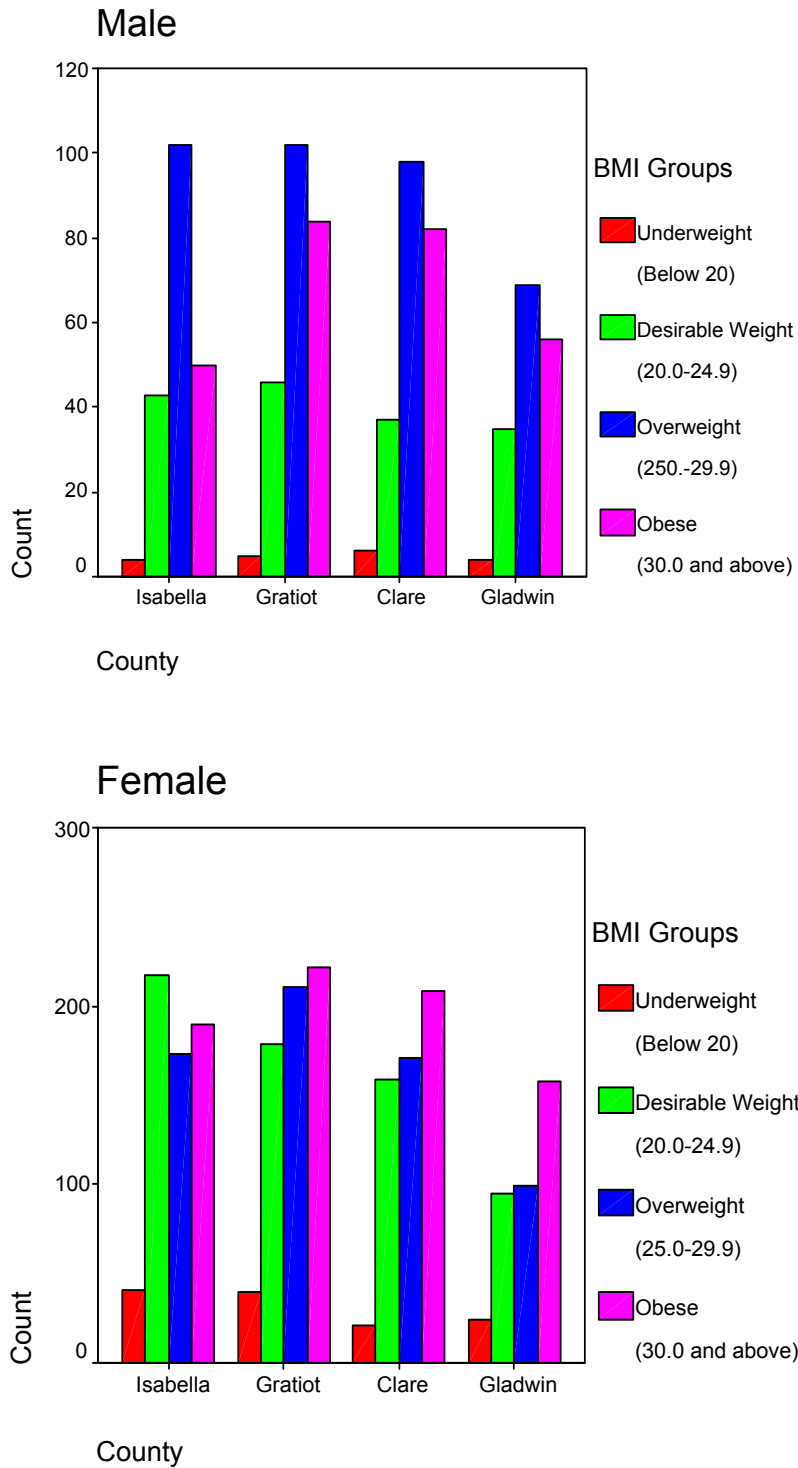


Figure 21. Body Mass Index and County Controlling for Gender

Table 13. Body Mass Index Groups and County of Residence Controlling for Age Groups

Age Groups			Body Mass Index Groups				Total	
			Under-weight (below 20)	Desirable Weight (20-24.9)	Over-weight (25-29.9)	Obese (30.0 and above)		
0 - 19 Years	County	Isabella	Count	2	6	2	4	14
			% within County	14.3%	42.9%	14.3%	28.6%	100.0%
			% of Total	2.0%	5.9%	2.0%	4.0%	13.9%
		Gratiot	Count	5	11	10	8	34
			% within County	14.7%	32.4%	29.4%	23.5%	100.0%
			% of Total	5.0%	10.9%	9.9%	7.9%	33.7%
		Clare	Count	3	5	3	3	14
			% within County	21.4%	35.7%	21.4%	21.4%	100.0%
			% of Total	3.0%	5.0%	3.0%	3.0%	13.9%
		Gladwin	Count	2	6	13	18	39
			% within County	5.1%	15.4%	33.3%	46.2%	100.0%
			% of Total	2.0%	5.9%	12.9%	17.8%	38.6%
Total		Count	12	28	28	33	101	
		% within County	11.9%	27.7%	27.7%	32.7%	100.0%	
20 to 39 Years	County	Isabella	Count	26	110	92	80	308
			% within County	8.4%	35.7%	29.9%	26.0%	100.0%
			% of Total	3.4%	14.5%	12.1%	10.5%	40.5%
		Gratiot	Count	12	57	71	60	200
			% within County	6.0%	28.5%	35.5%	30.0%	100.0%
			% of Total	1.6%	7.5%	9.3%	7.9%	26.3%
		Clare	Count	4	57	42	60	163
			% within County	2.5%	35.0%	25.8%	36.8%	100.0%
			% of Total	.5%	7.5%	5.5%	7.9%	21.4%
		Gladwin	Count	12	28	23	26	89
			% within County	13.5%	31.5%	25.8%	29.2%	100.0%
			% of Total	1.6%	3.7%	3.0%	3.4%	11.7%
Total		Count	54	252	228	226	760	
		% within County	7.1%	33.2%	30.0%	29.7%	100.0%	
40 to 59 Years	County	Isabella	Count	10	93	104	109	316
			% within County	3.2%	29.4%	32.9%	34.5%	100.0%
			% of Total	.8%	7.7%	8.6%	9.0%	26.1%
		Gratiot	Count	16	93	127	144	380
			% within County	4.2%	24.5%	33.4%	37.9%	100.0%
			% of Total	1.3%	7.7%	10.5%	11.9%	31.4%
		Clare	Count	12	79	106	119	316
			% within County	3.8%	25.0%	33.5%	37.7%	100.0%
			% of Total	1.0%	6.5%	8.8%	9.8%	26.1%
		Gladwin	Count	7	50	44	98	199
			% within County	3.5%	25.1%	22.1%	49.2%	100.0%
			% of Total	.6%	4.1%	3.6%	8.1%	16.4%
Total		Count	45	315	381	470	1211	
		% within County	3.7%	26.0%	31.5%	38.8%	100.0%	
60 to 79 Years	County	Isabella	Count	4	39	71	44	158
			% within County	2.5%	24.7%	44.9%	27.8%	100.0%
			% of Total	.5%	4.5%	8.2%	5.1%	18.3%
		Gratiot	Count	8	53	98	96	255
			% within County	3.1%	20.8%	38.4%	37.6%	100.0%
			% of Total	.9%	6.1%	11.3%	11.1%	29.5%
		Clare	Count	7	45	111	97	260
			% within County	2.7%	17.3%	42.7%	37.3%	100.0%
			% of Total	.8%	5.2%	12.8%	11.2%	30.1%
		Gladwin	Count	5	35	80	72	192
			% within County	2.6%	18.2%	41.7%	37.5%	100.0%
			% of Total	.6%	4.0%	9.2%	8.3%	22.2%

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		Total	Count	24	172	360	309	865
			% within County	2.8%	19.9%	41.6%	35.7%	100.0%
80 Years and Above	County Isabella		Count	1	8	4		13
			% within County	7.7%	61.5%	30.8%		100.0%
			% of Total	.9%	7.3%	3.7%		11.9%
	County Gratiot		Count	5	14	14	9	42
			% within County	11.9%	33.3%	33.3%	21.4%	100.0%
			% of Total	4.6%	12.8%	12.8%	8.3%	38.5%
	County Clare		Count	2	10	7	8	27
			% within County	7.4%	37.0%	25.9%	29.6%	100.0%
			% of Total	1.8%	9.2%	6.4%	7.3%	24.8%
	County Gladwin		Count	2	11	12	2	27
			% within County	7.4%	40.7%	44.4%	7.4%	100.0%
			% of Total	1.8%	10.1%	11.0%	1.8%	24.8%
Total			Count	10	43	37	19	109
			% within County	9.2%	39.4%	33.9%	17.4%	100.0%

This result is significant within 20-39 years old age group with χ^2 (9, n = 760) = 21.057, p = .012 (2 tailed). Among respondents who are between 20 and 39 years old, a higher percentage of residents of Isabella County maintain desirable weight, where as residents of Gratiot County have a higher tendency to be overweight and residents of Clare County to be obese.

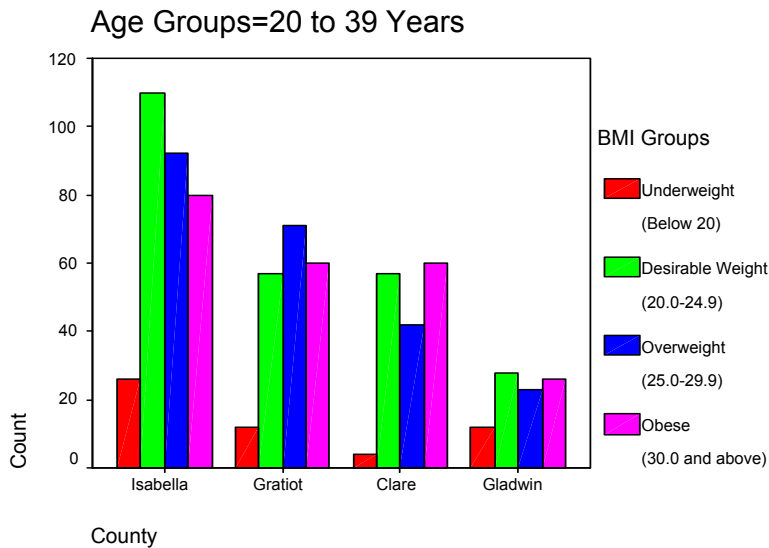


Figure 22. Body Mass Index and County of Residence Controlling for Age Group

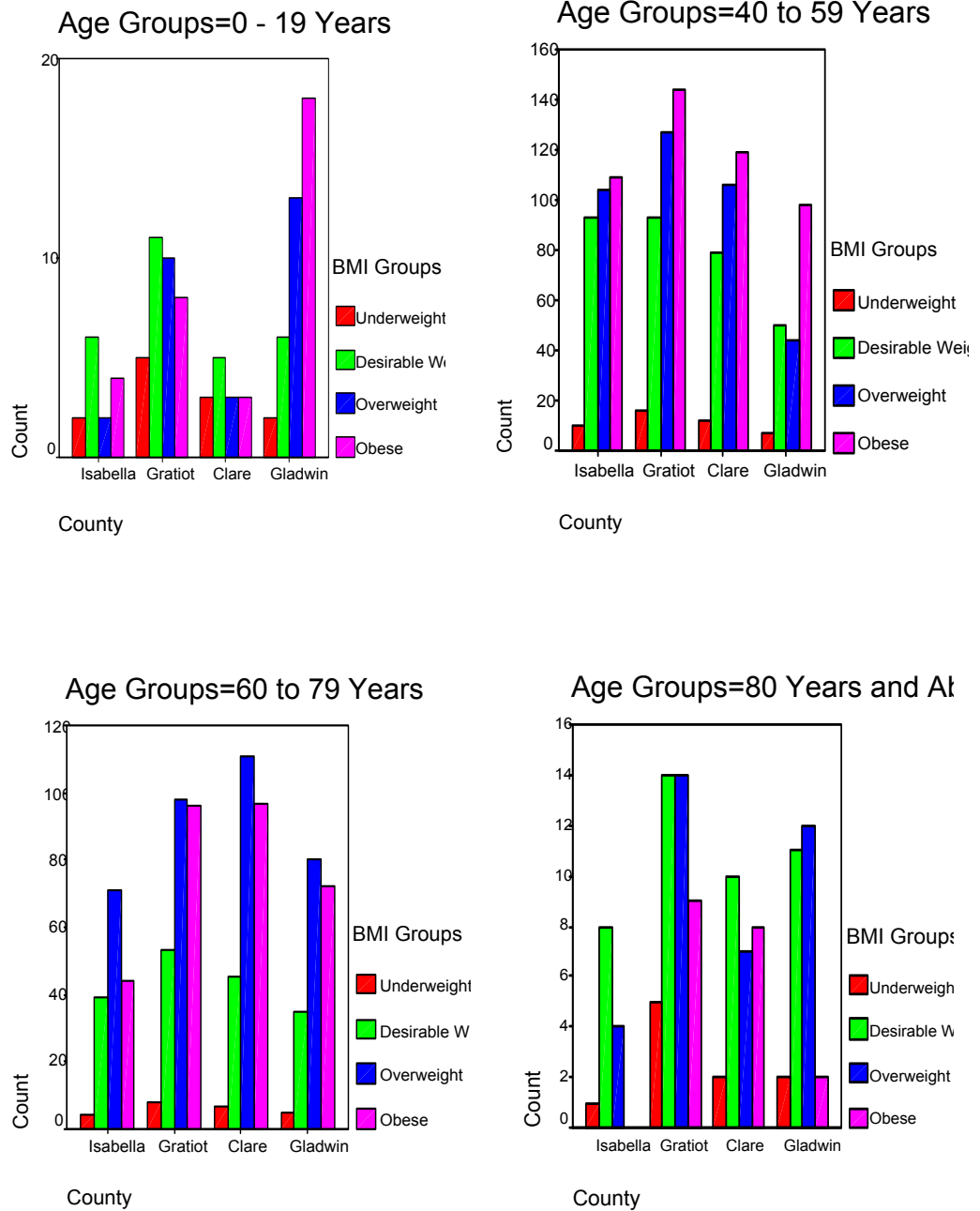


Figure 23. Body Mass Index and County of Residents Controlling for Age Groups

Table 14. Body Mass Index Groups and County of Residents Controlling for Age Groups and Gender

Gender	Age Groups	Body Mass Index Groups				Total				
		Underweight	Desirable Weight	Overweight	Obese					
Male	0 - 19 Years	County	Isabella	Count				2	2	
				% within County				100.0%	100.0%	
				% of Total				9.1%	9.1%	
		Gratiot	Count	1	2		5	8		
			% within County	12.5%	25.0%		62.5%	100.0%		
			% of Total	4.5%	9.1%		22.7%	36.4%		
		Clare	Count		2			2		
			% within County		100.0%			100.0%		
			% of Total		9.1%			9.1%		
		Gladwin	Count		2	7	1	10		
			% within County		20.0%	70.0%	10.0%	100.0%		
			% of Total		9.1%	31.8%	4.5%	45.5%		
	Total	Count	1	6	7	8	22			
		% within County	4.5%	27.3%	31.8%	36.4%	100.0%			
		% of Total	4.5%	27.3%	31.8%	36.4%	100.0%			
	20 to 39 Years	County	Isabella	Count	1	13	22	11	47	
				% within County	2.1%	27.7%	46.8%	23.4%	100.0%	
				% of Total	.8%	10.7%	18.2%	9.1%	38.8%	
			Gratiot	Count		9	17	11	37	
				% within County		24.3%	45.9%	29.7%	100.0%	
				% of Total		7.4%	14.0%	9.1%	30.6%	
			Clare	Count		3	11	8	22	
				% within County		13.6%	50.0%	36.4%	100.0%	
				% of Total		2.5%	9.1%	6.6%	18.2%	
			Gladwin	Count	1	6	7	1	15	
				% within County	6.7%	40.0%	46.7%	6.7%	100.0%	
				% of Total	.8%	5.0%	5.8%	.8%	12.4%	
		Total	Count	2	31	57	31	121		
			% within County	1.7%	25.6%	47.1%	25.6%	100.0%		
			% of Total	1.7%	25.6%	47.1%	25.6%	100.0%		
		40 to 59 Years	County	Isabella	Count	2	11	43	19	75
					% within County	2.7%	14.7%	57.3%	25.3%	100.0%
					% of Total	.7%	3.8%	14.8%	6.5%	25.8%
Gratiot	Count			3	16	36	32	87		
	% within County			3.4%	18.4%	41.4%	36.8%	100.0%		
	% of Total			1.0%	5.5%	12.4%	11.0%	29.9%		
Clare	Count			3	13	32	38	86		
	% within County			3.5%	15.1%	37.2%	44.2%	100.0%		
	% of Total			1.0%	4.5%	11.0%	13.1%	29.6%		
Gladwin	Count				12	10	21	43		
	% within County				27.9%	23.3%	48.8%	100.0%		
	% of Total				4.1%	3.4%	7.2%	14.8%		
Total	Count		8	52	121	110	291			
	% within County		2.7%	17.9%	41.6%	37.8%	100.0%			
	% of Total		2.7%	17.9%	41.6%	37.8%	100.0%			
60 to 79 Years	County		Isabella	Count	1	13	34	17	65	
				% within County	1.5%	20.0%	52.3%	26.2%	100.0%	
				% of Total	.3%	3.9%	10.2%	5.1%	19.5%	
		Gratiot	Count	1	14	42	32	89		
			% within County	1.1%	15.7%	47.2%	36.0%	100.0%		
			% of Total	.3%	4.2%	12.6%	9.6%	26.7%		
		Clare	Count	2	13	50	30	95		
			% within County	2.1%	13.7%	52.6%	31.6%	100.0%		
			% of Total	.6%	3.9%	15.0%	9.0%	28.5%		
		Gladwin	Count	3	9	40	32	84		
			% within County	3.6%	10.7%	47.6%	38.1%	100.0%		
			% of Total	.9%	2.7%	12.0%	9.6%	25.2%		
	Total	Count	7	49	166	111	333			
		% within County	2.1%	14.7%	49.8%	33.3%	100.0%			
		% of Total	2.1%	14.7%	49.8%	33.3%	100.0%			
80 Years	County	Isabella	Count		4	2		6		

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		and Above		% within County		66.7%	33.3%		100.0%
				% of Total		8.5%	4.3%		12.8%
			Gratiot	Count		5	7	4	16
				% within County		31.3%	43.8%	25.0%	100.0%
				% of Total		10.6%	14.9%	8.5%	34.0%
			Clare	Count	1	6	4	4	15
				% within County	6.7%	40.0%	26.7%	26.7%	100.0%
				% of Total	2.1%	12.8%	8.5%	8.5%	31.9%
			Gladwin	Count		5	5		10
				% within County		50.0%	50.0%		100.0%
				% of Total		10.6%	10.6%		21.3%
		Total		Count	1	20	18	8	47
				% within County	2.1%	42.6%	38.3%	17.0%	100.0%
				% of Total	2.1%	42.6%	38.3%	17.0%	100.0%
Female	0 - 19 Years	County	Isabella	Count	2	5	2	2	11
				% within County	18.2%	45.5%	18.2%	18.2%	100.0%
				% of Total	2.7%	6.8%	2.7%	2.7%	14.9%
			Gratiot	Count	3	9	10	2	24
				% within County	12.5%	37.5%	41.7%	8.3%	100.0%
				% of Total	4.1%	12.2%	13.5%	2.7%	32.4%
			Clare	Count	3	3	2	3	11
				% within County	27.3%	27.3%	18.2%	27.3%	100.0%
				% of Total	4.1%	4.1%	2.7%	4.1%	14.9%
			Gladwin	Count	2	4	6	16	28
				% within County	7.1%	14.3%	21.4%	57.1%	100.0%
				% of Total	2.7%	5.4%	8.1%	21.6%	37.8%
	Total	Count	10	21	20	23	74		
		% within County	13.5%	28.4%	27.0%	31.1%	100.0%		
		% of Total	13.5%	28.4%	27.0%	31.1%	100.0%		
	20 to 39 Years	County	Isabella	Count	25	97	70	69	261
				% within County	9.6%	37.2%	26.8%	26.4%	100.0%
				% of Total	3.9%	15.3%	11.0%	10.8%	41.0%
			Gratiot	Count	12	48	52	48	160
				% within County	7.5%	30.0%	32.5%	30.0%	100.0%
				% of Total	1.9%	7.5%	8.2%	7.5%	25.2%
			Clare	Count	4	54	31	52	141
				% within County	2.8%	38.3%	22.0%	36.9%	100.0%
				% of Total	.6%	8.5%	4.9%	8.2%	22.2%
			Gladwin	Count	11	22	16	25	74
				% within County	14.9%	29.7%	21.6%	33.8%	100.0%
				% of Total	1.7%	3.5%	2.5%	3.9%	11.6%
	Total	Count	52	221	169	194	636		
		% within County	8.2%	34.7%	26.6%	30.5%	100.0%		
		% of Total	8.2%	34.7%	26.6%	30.5%	100.0%		
	40 to 59 Years	County	Isabella	Count	8	82	61	89	240
				% within County	3.3%	34.2%	25.4%	37.1%	100.0%
				% of Total	.9%	9.0%	6.7%	9.8%	26.5%
			Gratiot	Count	13	74	90	109	286
				% within County	4.5%	25.9%	31.5%	38.1%	100.0%
				% of Total	1.4%	8.2%	9.9%	12.0%	31.5%
			Clare	Count	9	66	74	81	230
				% within County	3.9%	28.7%	32.2%	35.2%	100.0%
				% of Total	1.0%	7.3%	8.2%	8.9%	25.4%
			Gladwin	Count	7	37	31	76	151
				% within County	4.6%	24.5%	20.5%	50.3%	100.0%
				% of Total	.8%	4.1%	3.4%	8.4%	16.6%
	Total	Count	37	259	256	355	907		
		% within County	4.1%	28.6%	28.2%	39.1%	100.0%		
		% of Total	4.1%	28.6%	28.2%	39.1%	100.0%		
	60 to 79 Years	County	Isabella	Count	3	26	37	25	91
				% within County	3.3%	28.6%	40.7%	27.5%	100.0%
				% of Total	.6%	5.1%	7.3%	4.9%	17.9%
Gratiot			Count	7	37	49	58	151	
			% within County	4.6%	24.5%	32.5%	38.4%	100.0%	
			% of Total	1.4%	7.3%	9.7%	11.4%	29.8%	
Clare			Count	4	31	60	67	162	
			% within County	2.5%	19.1%	37.0%	41.4%	100.0%	
			% of Total	.8%	6.1%	11.8%	13.2%	32.0%	

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80 Years and Above	Total	Gladwin	Count	2	25	38	38	103	
			% within County	1.9%	24.3%	36.9%	36.9%	100.0%	
			% of Total	.4%	4.9%	7.5%	7.5%	20.3%	
		Total	Isabella	Count	16	119	184	188	507
				% within County	3.2%	23.5%	36.3%	37.1%	100.0%
	County	Isabella	Count	1	4	2		7	
			% within County	14.3%	57.1%	28.6%		100.0%	
			% of Total	1.7%	6.7%	3.3%		11.7%	
		Gratiot	Count	5	9	7	4	25	
			% within County	20.0%	36.0%	28.0%	16.0%	100.0%	
			% of Total	8.3%	15.0%	11.7%	6.7%	41.7%	
		Clare	Count	1	4	3	4	12	
			% within County	8.3%	33.3%	25.0%	33.3%	100.0%	
			% of Total	1.7%	6.7%	5.0%	6.7%	20.0%	
		Gladwin	Count	2	5	7	2	16	
% within County			12.5%	31.3%	43.8%	12.5%	100.0%		
% of Total			3.3%	8.3%	11.7%	3.3%	26.7%		
Total		Count	9	22	19	10	60		
		% within County	15.0%	36.7%	31.7%	16.7%	100.0%		
	% of Total	15.0%	36.7%	31.7%	16.7%	100.0%			

The result is significant for female respondents who are between 20 to 39 years old with $\chi^2 (9, n = 636) = 19.696, p = .020$ (2 tailed). Among women who are between 20 to 39 years old, there is a higher tendency to maintain desirable weight for residents of Isabella and Clare Counties, while being overweight for Gratiot County women, and being obese for residents of Clare County and Gladwin County. Clare County women tend to either be in the desirable (BMI 20-24.9) or obese (BMI 30.0 and above) categories and not in the overweight (BMI 25-29.9) category.

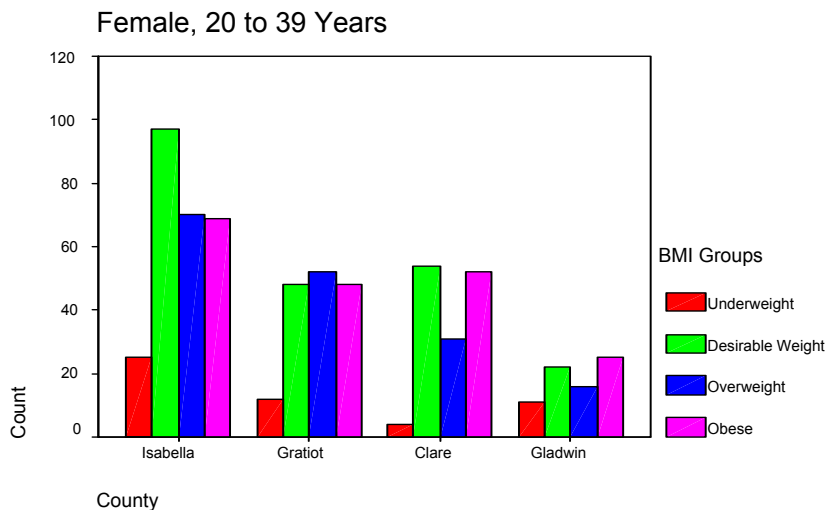


Figure 24. Body Mass Index and County Controlling for Gender and Age Group
Table 15. Body Mass Index Groups and Education Level

			Body Mass Index Groups				Total
			Underweight	Desirable Weight	Overweight	Obese	
Highest grade completed in school	8th grade or less	Count	4	10	8	25	47
		% Within education level	8.5%	21.3%	17.0%	53.2%	100.0%
		% Of Total	.1%	.3%	.3%	.8%	1.6%
	Some high school	Count	8	27	53	52	140
		% Within education level	5.7%	19.3%	37.9%	37.1%	100.0%
		% Of Total	.3%	.9%	1.8%	1.8%	4.7%
	High school graduate	Count	33	231	288	320	872
		% Within education level	3.8%	26.5%	33.0%	36.7%	100.0%
		% Of Total	1.1%	7.8%	9.8%	10.8%	29.5%
	Some college	Count	47	279	359	388	1073
		% Within education level	4.4%	26.0%	33.5%	36.2%	100.0%
		% Of Total	1.6%	9.5%	12.2%	13.1%	36.4%
	Bachelor's degree	Count	31	148	159	157	495
		% Within education level	6.3%	29.9%	32.1%	31.7%	100.0%
		% Of Total	1.1%	5.0%	5.4%	5.3%	16.8%
	Master's degree	Count	14	82	107	64	267
		% Within education level	5.2%	30.7%	40.1%	24.0%	100.0%
		% Of Total	.5%	2.8%	3.6%	2.2%	9.0%
	Doctoral degree	Count	2	19	27	9	57
		% Within education level	3.5%	33.3%	47.4%	15.8%	100.0%
		% Of Total	.1%	.6%	.9%	.3%	1.9%
	Total	Count	139	796	1001	1015	2951
		% Within education level	4.7%	27.0%	33.9%	34.4%	100.0%
		% Of Total	4.7%	27.0%	33.9%	34.4%	100.0%

There is a significant association between body mass index group and education level with $\chi^2 (18, n = 2,951) = 48.355, p = .000$ (2 tailed). Respondents with bachelor's degree or higher have a higher tendency to maintain desirable weight than respondents with less education. 30.4% of respondents with bachelor's degree or higher belong to the desirable weight category, as compared to 25.7% of respondents with less education. 28.1% of respondents with a bachelor's degree or higher are considered obese compared to 36.8% of respondents with less education.

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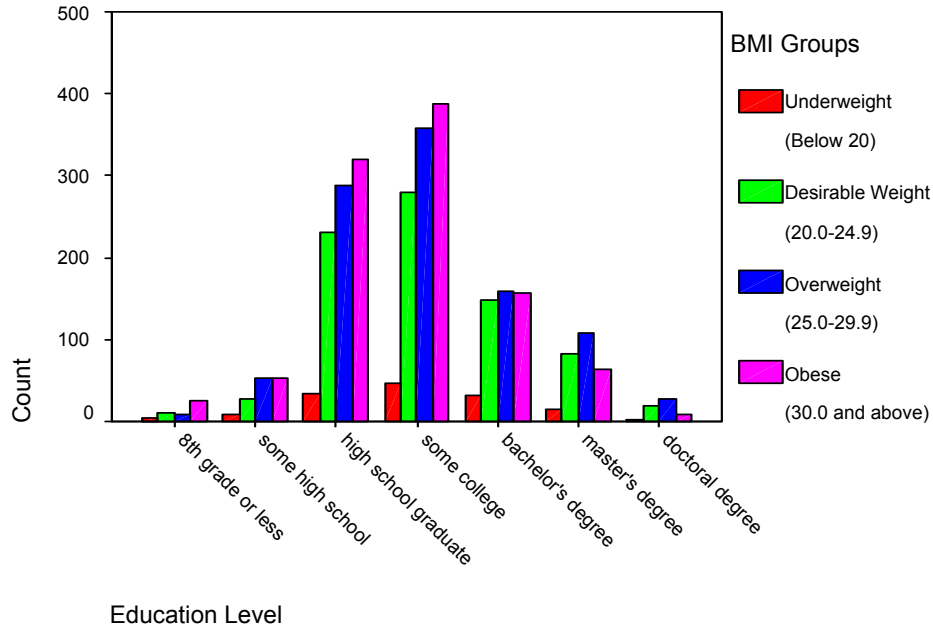


Figure 25. Body Mass Index Groups and Education Level (count)

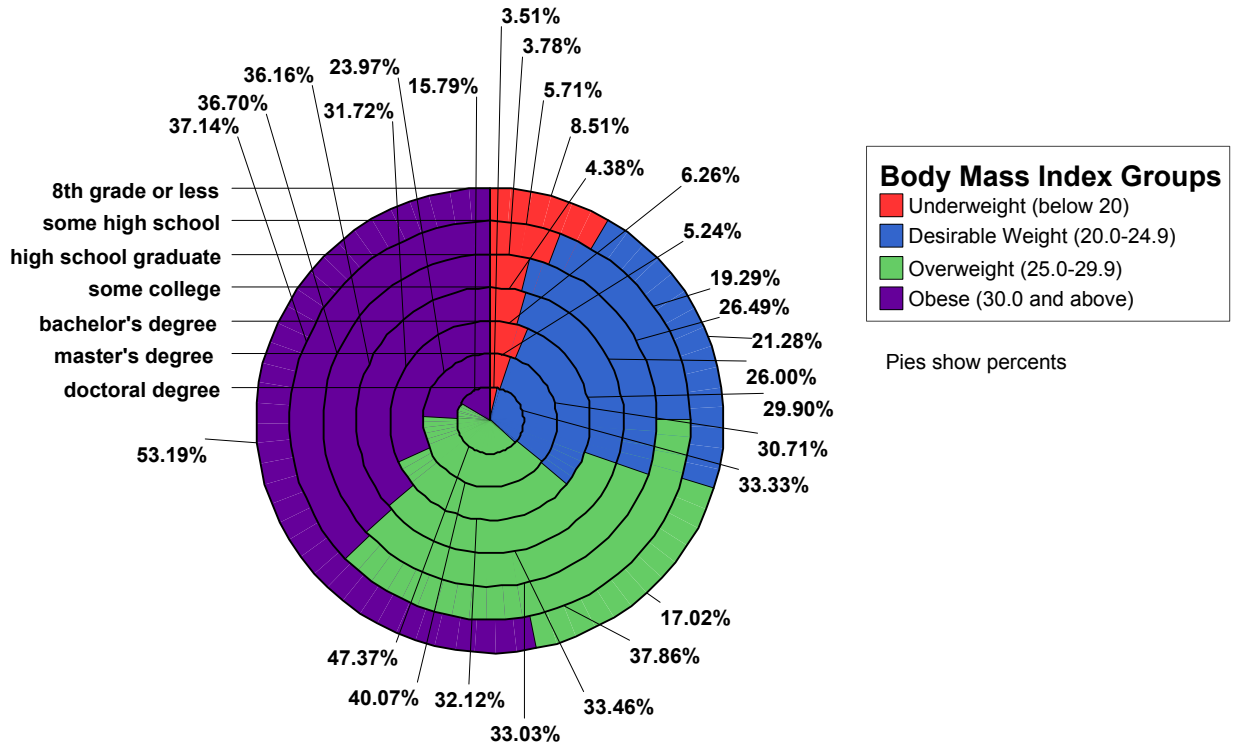


Figure 26. Body Mass Index Group and Education Level (percentile)

Table 16. Body Mass Index Groups and Family/Household Income Last Year

Body Mass Index Groups	Total
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Disclaimer: Recommendations and interventions are at the discretion of the reader.

			Underweight	Desirable Weight	Overweight	Obese	
Family/ household income last year	Under \$20,000	Count	43	161	161	231	596
		% within family income	7.2%	27.0%	27.0%	38.8%	100.0%
		% of Total	1.5%	5.7%	5.7%	8.2%	21.0%
	\$20,000 - \$29,999	Count	23	113	167	184	487
		% within family income	4.7%	23.2%	34.3%	37.8%	100.0%
		% of Total	.8%	4.0%	5.9%	6.5%	17.2%
	\$30,000 - \$39,999	Count	14	99	156	157	426
		% within family income	3.3%	23.2%	36.6%	36.9%	100.0%
		% of Total	.5%	3.5%	5.5%	5.5%	15.0%
	\$40,000 - \$49,999	Count	14	79	112	128	333
		% within family income	4.2%	23.7%	33.6%	38.4%	100.0%
		% of Total	.5%	2.8%	4.0%	4.5%	11.8%
	\$50,000 - \$59,999	Count	10	89	82	98	279
		% within family income	3.6%	31.9%	29.4%	35.1%	100.0%
		% of Total	.4%	3.1%	2.9%	3.5%	9.8%
	\$60,000 - \$69,999	Count	7	51	73	71	202
		% within family income	3.5%	25.2%	36.1%	35.1%	100.0%
		% of Total	.2%	1.8%	2.6%	2.5%	7.1%
	\$70,000 - \$79,999	Count	9	46	50	57	162
		% within family income	5.6%	28.4%	30.9%	35.2%	100.0%
% of Total		.3%	1.6%	1.8%	2.0%	5.7%	
\$80,000 - \$89,999	Count	2	37	36	28	103	
	% within family income	1.9%	35.9%	35.0%	27.2%	100.0%	
	% of Total	.1%	1.3%	1.3%	1.0%	3.6%	
\$90,000 - \$99,999	Count	4	25	30	17	76	
	% within family income	5.3%	32.9%	39.5%	22.4%	100.0%	
	% of Total	.1%	.9%	1.1%	.6%	2.7%	
\$100,000 per year or more	Count	8	52	69	40	169	
	% within family income	4.7%	30.8%	40.8%	23.7%	100.0%	
	% of Total	.3%	1.8%	2.4%	1.4%	6.0%	
Total	Count	134	752	936	1011	2833	
	% within family income	4.7%	26.5%	33.0%	35.7%	100.0%	
	% of Total	4.7%	26.5%	33.0%	35.7%	100.0%	

There is a significant association between body mass index group and family income with χ^2 (27, n = 2,833) = 57.568, p = .001 (2 tailed). Respondents with family incomes under \$50,000 a year tend to have higher BMIs than respondents with family incomes at or above \$50,000 a year. Compared to 24.5% of respondents in the desirable weight category with family incomes under \$50,000 a year, 30.3% of respondents with family incomes at or above \$50,000 a year are in the desirable weight category. 70.4% of respondents with family incomes under \$50,000 a year are considered either overweight or obese, while 65.7% of

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respondents with family incomes at or above \$50,000 a year belong to either the overweight or obese group.

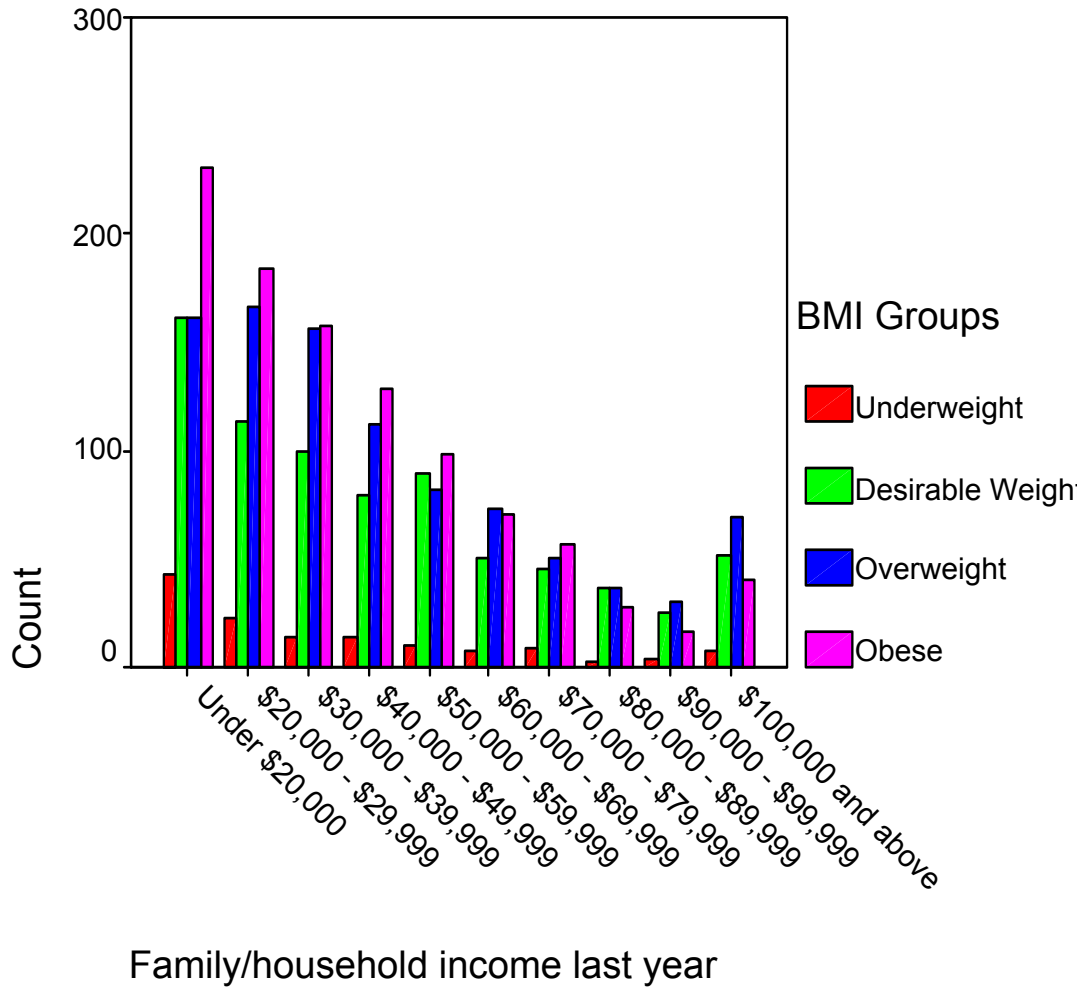


Figure 27. Body Mass Index and Family Income

Table 17. Body Mass Index Group and County of Residence Controlling for Family Income Last Year

Family	Body Mass Index Groups				Total
	Underweight	Desirable Weight	Overweight	Obese	

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income								
Under \$20,000	County	Isabella	Count	8	38	37	40	123
			% within County	6.5%	30.9%	30.1%	32.5%	100.0%
		Gratiot	Count	12	48	32	58	150
			% within County	8.0%	32.0%	21.3%	38.7%	100.0%
		Clare	Count	12	44	58	78	192
			% within County	6.3%	22.9%	30.2%	40.6%	100.0%
		Gladwin	Count	11	31	34	55	131
			% within County	8.4%	23.7%	26.0%	42.0%	100.0%
	Total		Count	43	161	161	231	596
			% within County	7.2%	27.0%	27.0%	38.8%	100.0%
Between \$20,000 - \$29,999	County	Isabella	Count	10	30	36	36	112
			% within County	8.9%	26.8%	32.1%	32.1%	100.0%
		Gratiot	Count	7	27	46	48	128
			% within County	5.5%	21.1%	35.9%	37.5%	100.0%
		Clare	Count	4	34	49	58	145
			% within County	2.8%	23.4%	33.8%	40.0%	100.0%
		Gladwin	Count	2	22	36	42	102
			% within County	2.0%	21.6%	35.3%	41.2%	100.0%
	Total		Count	23	113	167	184	487
			% within County	4.7%	23.2%	34.3%	37.8%	100.0%
Between \$30,000 - \$39,999	County	Isabella	Count	3	41	42	31	117
			% within County	2.6%	35.0%	35.9%	26.5%	100.0%
		Gratiot	Count	4	25	48	37	114
			% within County	3.5%	21.9%	42.1%	32.5%	100.0%
		Clare	Count	1	22	35	48	106
			% within County	.9%	20.8%	33.0%	45.3%	100.0%
		Gladwin	Count	6	11	31	41	89
			% within County	6.7%	12.4%	34.8%	46.1%	100.0%
	Total		Count	14	99	156	157	426
			% within County	3.3%	23.2%	36.6%	36.9%	100.0%
Between \$40,000 - \$49,999	County	Isabella	Count	2	19	27	29	77
			% within County	2.6%	24.7%	35.1%	37.7%	100.0%
		Gratiot	Count	5	27	37	50	119
			% within County	4.2%	22.7%	31.1%	42.0%	100.0%
		Clare	Count	3	19	32	32	86
			% within County	3.5%	22.1%	37.2%	37.2%	100.0%
		Gladwin	Count	4	14	16	17	51
			% within County	7.8%	27.5%	31.4%	33.3%	100.0%
	Total		Count	14	79	112	128	333
			% within County	4.2%	23.7%	33.6%	38.4%	100.0%
Between \$50,000 - \$59,999	County	Isabella	Count	3	28	28	27	86
			% within County	3.5%	32.6%	32.6%	31.4%	100.0%
		Gratiot	Count	4	28	32	37	101
			% within County	4.0%	27.7%	31.7%	36.6%	100.0%
		Clare	Count	3	23	14	18	58
			% within County	5.2%	39.7%	24.1%	31.0%	100.0%
		Gladwin	Count		10	8	16	34
			% within County		29.4%	23.5%	47.1%	100.0%
	Total		Count	10	89	82	98	279
			% within County	3.6%	31.9%	29.4%	35.1%	100.0%
Between \$60,000 - \$69,999	County	Isabella	Count	3	24	25	28	80
			% within County	3.8%	30.0%	31.3%	35.0%	100.0%
		Gratiot	Count	2	11	25	23	61

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			% within County	3.3%	18.0%	41.0%	37.7%	100.0%
		Clare	Count	1	11	13	9	34
			% within County	2.9%	32.4%	38.2%	26.5%	100.0%
		Gladwin	Count	1	5	10	11	27
			% within County	3.7%	18.5%	37.0%	40.7%	100.0%
	Total		Count	7	51	73	71	202
			% within County	3.5%	25.2%	36.1%	35.1%	100.0%
Between \$70,000 - 79,999	County	Isabella	Count	4	15	18	17	54
			% within County	7.4%	27.8%	33.3%	31.5%	100.0%
		Gratiot	Count	4	12	16	17	49
			% within County	8.2%	24.5%	32.7%	34.7%	100.0%
		Clare	Count		12	10	14	36
			% within County		33.3%	27.8%	38.9%	100.0%
		Gladwin	Count	1	7	6	9	23
			% within County	4.3%	30.4%	26.1%	39.1%	100.0%
	Total		Count	9	46	50	57	162
			% within County	5.6%	28.4%	30.9%	35.2%	100.0%
Between \$80,000 - \$89,999	County	Isabella	Count	1	16	8	9	34
			% within County	2.9%	47.1%	23.5%	26.5%	100.0%
		Gratiot	Count		7	18	8	33
			% within County		21.2%	54.5%	24.2%	100.0%
		Clare	Count		6	5	4	15
			% within County		40.0%	33.3%	26.7%	100.0%
		Gladwin	Count	1	8	5	7	21
			% within County	4.8%	38.1%	23.8%	33.3%	100.0%
	Total		Count	2	37	36	28	103
			% within County	1.9%	35.9%	35.0%	27.2%	100.0%
Between \$90,000 - 99,999	County	Isabella	Count		13	10	7	30
			% within County		43.3%	33.3%	23.3%	100.0%
		Gratiot	Count	3	7	7	8	25
			% within County	12.0%	28.0%	28.0%	32.0%	100.0%
		Clare	Count	1	3	8	1	13
			% within County	7.7%	23.1%	61.5%	7.7%	100.0%
		Gladwin	Count		2	5	1	8
			% within County		25.0%	62.5%	12.5%	100.0%
	Total		Count	4	25	30	17	76
			% within County	5.3%	32.9%	39.5%	22.4%	100.0%
\$100,000 per year or more	County	Isabella	Count	5	20	23	9	57
			% within County	8.8%	35.1%	40.4%	15.8%	100.0%
		Gratiot	Count	1	15	24	17	57
			% within County	1.8%	26.3%	42.1%	29.8%	100.0%
		Clare	Count	1	13	17	8	39
			% within County	2.6%	33.3%	43.6%	20.5%	100.0%
		Gladwin	Count	1	4	5	6	16
			% within County	6.3%	25.0%	31.3%	37.5%	100.0%
	Total		Count	8	52	69	40	169
			% within County	4.7%	30.8%	40.8%	23.7%	100.0%

There is a significant association between body mass index group and county of residence controlling for family income within a group of family income between \$30,000 and \$39,999 with $\chi^2 (9, n = 426) = 26.624, p = .002$ (2 tailed). There is a higher tendency of

residents of Isabella County to maintain desirable weight among the respondents with family incomes between \$30,000 and \$39,999; 35% of residents of Isabella County maintain desirable weight whereas only 18.7% of residents of Gratiot, Clare and Gladwin County do; and whereas 26.5% of Isabella County residents are considered obese, 32.5% of Gratiot County residents, 45.3% of Clare County residents, and 36.9% of Gladwin County residents are considered obese.

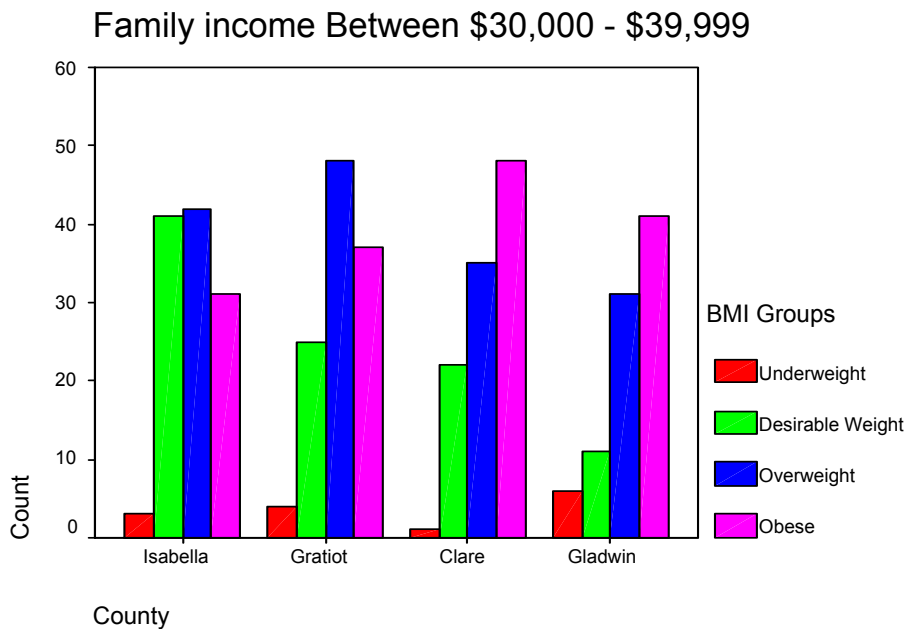


Figure 28. Body Mass Index Groups and County of Residence Controlling for Family Income (Between \$30,000-\$39,999)

Summary

As the results indicate, nearly two thirds of residents in the counties surveyed are considered either overweight or obese, it is critically important to undertake interventions urgently to improve the current BMI associated problems in these four counties.