A cohort analysis of the cardiovascular risk factors in the employees of a pediatric hospital from 2009 to 2012

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A retrospective longitudinal cohort regression analysis was completed in 853 of the 3435 employees of Cook Children's Hospital who participated all 4 years (2009 to 2012) in an employer wellness program. The presence of the metabolic syndrome (MS) was used as an outcome measure for the success of the wellness program. Data were stratified by weight, gender, and ethnicity. The odds ratios and regression analysis showed a significant decline in MS over the 4 years of the study ($P = 0.008$), as well as a significant association between MS and obesity and overweight status ($P < 0.0001$), male gender ($P = 0.0018$), and all ethnic categories ($P < 0.05$) except African American ethnicity and the multiple ethnicity category. Age was strongly associated with risk for MS. Overall, the study showed that the wellness program significantly decreased the incidence of MS ($P < 0.05$).

The metabolic syndrome (MS) is a serious public health concern defined by interconnected factors that directly impact the risk of coronary heart disease. MS has been defined by the International Diabetes Federation (IDF) and the National Cholesterol Education Program (3). Both groups present similar criteria for MS, but for purposes of this study the IDF definition, which put more emphasis on waist circumference, was used. Waist circumference, independent of other parameters of MS, is the most significant predictor of cardiovascular risk (1–3). This study identified trends in the prevalence of MS in 853 employees who consistently participated in a hospital wellness program from 2009 to 2012.

METHODS

The study was approved by the Cook Children's Hospital institutional review board. A retrospective longitudinal cohort regression analysis was completed on 853 (24.8%) volunteers who had participated in all 4 years of a hospital wellness program from 2009 to 2012 and had submitted complete demographic records. A total of 2582 employees were excluded from the study because they participated inconsistently during the study period. Participants in the wellness program were incentivized with an annual monetary award to reduce their cardiovascular risk by reducing four or more of the measured criteria in 2 consecutive years. Each participant's demographic information was obtained from survey health questionnaires collected by the

employer's wellness coordinator. Measured parameters such as weight, waist circumference, height, and systolic and diastolic blood pressures were obtained annually by registered nurses. No formal instruction on how to reduce these parameters was given to participants. They were referred to their personal doctors for direction or sought out resources to improve their health.

All data were analyzed by statisticians using SAS. Two models were used to analyze the variables affecting MS risk: a conventional logistic regression and a longitudinal generalized estimated equation (GEE) model. Model 1 for the output analysis is shown below:

$$\text{Logit}[P(\text{MS} = 1)] = \beta_0 + \beta_1 * \sqrt{t} + \beta_3 * \text{WeightStatus} + \beta_4 * \text{Gender} + \beta_5 * \text{Ethnicity}$$

Odds ratio estimates were used to evaluate risk. Both analyses molded in risk factor variables including square root of time, gender, weight status (normal, overweight, and obese), ethnicities (American Indian, Asian, Black, Hispanic other, Hispanic White, Multiple, and White), and age groups (18–30, 30–40, 40–50, 50–65, and 65+). In both regression models, 2009 was the baseline. Normal weight was used as the baseline and compared with overweight and obese categories. The underweight were excluded due to the very small numbers in this category. Caucasian (White) ethnicity was set as the baseline and compared to Asian, African American (Black), Hispanic Other, Hispanic White, American Indian, and Pacific Islander ethnicities. For age, the 18–30 age group was used as the reference group, and all other age categories were compared to it. All analyses were performed using SAS (V9.2).

RESULTS

Table 1 presents the demographic characteristics of the 853 participants who were eligible for longitudinal study. More

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Table 1. Demographic characteristics of the 853 hospital employees in the cohort

Category	Variable	Female	Male	All
Gender	Employee gender	788 (92%)	65 (8%)	853
Ethnicity	American Indian*	4 (100%)	0	4
	Asian	18 (90%)	2 (10%)	20
	African American (Black)	67 (98%)	1 (2%)	68
	Hispanic other	52 (98%)	1 (2%)	53
	Hispanic White	108 (93%)	8 (7%)	116
	Multiple	15 (94%)	1 (6%)	16
	Pacific Islander*	1 (100%)	0	1
	Caucasian (White)	523 (91%)	52 (9%)	575
Age group	18–30	166 (98%)	3 (2%)	169
	30–40	253 (91%)	26 (9%)	279
	40–50	206 (91%)	24 (9%)	230
	50–65	159 (94%)	10 (6%)	169
	65+	4 (67%)	2 (33%)	6

*Excluded from the study due to small size.

Table 2. Regression analysis of the metabolic syndrome from 2009 to 2012, stratified by weight, gender, and ethnicity in 853 employees of a pediatric hospital

Variable	Parameter*	DF	Standard estimate	Wald error	Chi-square	Significance
Intercept		1	−1.031	0.15	45.85	<.0001
Square root of time†		1	−0.15	0.079	3.7	0.06
Obesity	0	1	1.46	0.083	309.4	<.0001
Overweight	1	1	0.43	0.085	24.5	<.0001
Gender	0	1	0.33	0.085	15.4	<.0001
Asian	0	1	1.29	0.30	18.4	<.0001
Black	1	1	−0.77	0.178	18.7	<.0001
Hispanic other	2	1	0.19	0.179	1.0	0.3
Hispanic white	3	1	0.28	0.14	3.9	0.05
Multiple ethnicities	4	1	−0.71	0.35	4.2	0.04

*Weight = 0 for obese and 1 for overweight vs normal; gender = 0 for males vs females; G = 0, 1, 2, 3, 4 for Asian, Black, Hispanic other, Hispanic White, and Multiple vs White.

†Square root of time = year 2009 to 2012.

than 90% of participants were women, and 575 of 853 (67%) were Caucasian. At baseline, the mean age was 39 years for the women and 42 years for the men. Because of the small sample in the ethnic groups of American Indian and Pacific Islander, these individuals were excluded from the analysis. We found that more obese individuals migrated to the overweight category than overweight individuals migrated towards the obese category. The normal weight rate kept stable over the 4 years.

The logistic regression model validated a decline of MS over time ($P = 0.02$), showing that the program was effective in reducing MS over time in the entire cohort (Table 2). There was an increased risk of MS in both the obese and overweight categories ($P < 0.0001$) compared with the normal weight group. MS risk increased in men using women as a reference ($P < 0.0001$), as well as in Asians ($P < 0.0001$), Blacks ($P < 0.0001$), Hispanic Whites ($P = 0.0495$), and multiple races ($P = 0.04$).

The data were also analyzed to determine odds ratios (OR). There was an overall decrease in the odds of MS in this cohort from 2009 to 2012 (OR = 0.84, $P = 0.02$). The odds of having MS were the highest in the obese category (OR = 20.37, $P < 0.0001$), followed by the overweight category (OR = 7.42, $P < 0.0001$). Men were almost twice as likely to have MS (OR = 2.02, $P < 0.0001$) as women. If all other factors were controlled, several ethnicities had an increased odds of having MS, including Hispanic other (OR = 2.02, $P = 0.0001$), Hispanic White (OR = 1.87, $P < 0.0001$), and Asians, who had the highest risk for MS (OR = 4.46, $P < 0.0001$). In contrast, African Americans had a decreased odds of having MS (OR = 0.69, $P = 0.03$). Age groups older than the 18–30 year reference group had increased odds of having MS, including the

40–50 year group (OR = 1.66, $P = 0.0015$) and the 50–65 year group (OR = 2.22, $P = 0.0001$).

The results using the longitudinal GEE logistic model on the right side of Table 3 confirm a significant decline of MS over the 4 years of the study ($P = 0.004$). The same significant association between MS and the obese and overweight groups was found ($P < 0.0001$), as well as the increased MS in men ($P = 0.0008$) when compared to women. Furthermore, a significant association between MS and most ethnicities ($P < 0.0001$) except for the African American and American Indian categories ($P = 0.23$ and 0.4 , respectively) was found. This model also showed that all subjects older than 30 years had a significantly increased risk for MS, including the 40–50 year group ($P < 0.0086$) and 50–65 year group ($P < 0.0001$), when compared to baseline.

DISCUSSION

There are not many cohort studies that follow MS over time. Even fewer longitudinal studies have been conducted that focus on MS and ethnicity factors. Due to limited data, we could not evaluate the effect of smoking status on the model. However, smoking status has been found to have a significant effect on MS in other studies (2). Having a high risk of MS in older age is consistent with Sun's finding in 2012 (3).

Our finding on the different risks in ethnicities and possible protective factors in African Americans in one model of the longitudinal study is new in the research of MS. It suggests that African Americans can have better health if obesity and other factors are better controlled. More research is needed to evaluate what these protective factors are, since it was not corroborated

Table 3. The impact of a wellness program over time on the metabolic syndrome parameters in 853 employees of a pediatric hospital, stratified by weight, gender, and ethnicity

Parameter		Estimate	GEE standard error	95% confidence		Z	Pr> Z
				Parameter error	Estimates		
Intercept		−3.16	0.19	−3.53	−2.7929	−16.8	<.0001
Square root of time*		−0.17	0.063	−0.29	−0.044	−2.65	0.008
Obese	0	2.78	0.21	2.37	3.19	13.17	<.0001
Overweight	1	1.93	0.20	1.54	2.31	9.84	<.0001
Normal weight	2	0	0	0	0		
Male	0	0.71	0.23	0.26	1.16	3.11	0.002
Female	1	0	0	0	0		
Asian	0	1.29	0.44	0.42	2.14	2.92	0.003
Black	1	−0.39	0.26	−0.90	0.12	−1.49	0.13
Hispanic other	2	0.54	0.27	0.004	1.08	1.98	0.05
Hispanic white	3	0.58	0.21	0.17	0.99	2.74	0.006
Multiple ethnicity	4	−0.34	0.69	−1.70	1.01	−0.5	0.62
White	5	0	0	0	0		
<30 y	0	−0.52	0.24	−0.99	0.05	−2.17	0.03
30–40 y	1	−0.34	0.15	−0.63	−0.05	−2.26	0.03
>40 y	2	0.00	0.00	0.00	0.00		

*Square root of time = year 2009 to 2012.

GEE indicates generalized estimated equation.

by the second model, to assess if these are true factors, whether genetic, nutritional, or environmental.

The study showed an overall decline of MS over time in the obese and overweight categories during the 4 years of the study, which indicates movement away from increased cardiovascular risk. Certainly, the differences in MS in different ethnicities warrant more research to assess whether there are genetic, cultural, or environmental factors that are worth studying for future interventional strategies. Night shift employees—those who do not work in daytime hours—comprise 20% of the US workforce and are more predisposed to have MS (3). Hospitals depend on shift workers. Factors associated with rapid progression toward getting MS for middle-aged workers include persistent day-night rotating shift work, shift duration, education, length of employment, age, differences in diet, body mass index, total cholesterol, triglycerides, job strain, sedentary activity, dietary style, and smoking (4–12, 15, 16). Educational level may be a confounding factor in MS as it impacts shift work. Animal studies indicate that shifts in usual mealtimes which impact the diurnal rhythms of carbohydrate and lipid metabolism pose critical implications for MS risk in shift workers (12). Socio-economic factors such as income have unknown effects on shift work and MS.

Criteria for MS are used in many wellness programs to generate information about cardiovascular health for employees. Yet the longitudinal success of wellness programs is rarely

followed over time despite substantial monetary investments by employers. Measuring grouped criteria outcomes and providing feedback such as provided by this study to employees is vital to initiating change within an employee base (13–15).

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Proceedings' annual editorial board meeting

Baylor University Medical Center Proceedings held its annual editorial board meeting on February 12, 2014. Some of the main points discussed were as follows:

- In 2013, published 107 manuscripts and 448 pages (*Table*), with an acceptance rate of 83% (107/129). The number of submissions was an all-time high.
- Received 78% of the published manuscripts from Baylor Health Care System physicians.
- Signed an agreement with CNKI, the largest aggregator and distributor of academic digital resources in China. We have agreements with numerous US aggregators as well, including Ebsco, Gale, and ProQuest.
- Began using Twitter for journal announcements (@BaylorHealth.edu).
- Printed 7100 copies of each issue.
- Had a budget of about \$180,000.
- Received nearly 2 million visits to our PubMed Central website in 2013, representing about 1.2 million unique visitors.

Table. Numbers of articles and pages published in BUMC Proceedings in 2013

Content	Jan 13		Apr 13		Jul 13		Oct 13		Total	
	Art	Pp	Art	Pp	Art	Pp	Art	Pp	Art	Pp
Case reports	18	51	15	41	16	40	11	29	60	161
Original articles	2	7	6	25	6	27	4	19	18	78
Reviews			3	22	4	16			7	38
Editorials, tributes	2	10	4	8			2	4	8	22
Interviews					2	18			2	18
Historical articles			2	4			1	6	3	10
Facts and ideas	1	11	1	10	1	14	1	10	4	45
Book reviews			1	2	2	3	2	2	5	7
Miscellaneous*	6	13	7	28	6	10	8	18	27	69
Total	23	92	32	140	31	128	21	88	107	448

*Miscellaneous includes the copyright page, Baylor news, obituaries, journal notices, abstracts, guidelines for authors, ads, index, and publications list. Not included are items that appear at the end of articles. The miscellany items are not included in the total article count.