

# PREVENTING CARDIOVASCULAR DISEASE IN KENTUCKY: EPIDEMIOLOGY, TRENDS, AND STRATEGIES FOR THE FUTURE

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*Cardiovascular disease (CVD) is the leading cause of death in the United States despite dramatic improvement in the treatment of heart disease in recent years. Kentucky leads the nation in the prevalence of several individual risk factors for cardiovascular disease, the prevalence of multiple risk factors, and in cardiovascular mortality. While trends in the prevalence of some of these cardiac risk factors have shown improvement, others have remained unchanged or have worsened. The increased prevalence of obesity and diabetes, especially among young persons, is one of the most worrisome trends. The*

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*prevalence of smoking in Kentucky remains high, and has not declined substantially in the past fifteen years. As a consequence of poverty, low educational levels, a high unemployment rate, and often limited access to medical care, select populations in the Appalachian region of the state have among the highest rates of cardiovascular disease in the developed world. In the 2004 Behavioral Risk Factor*

## CME INFORMATION

### TARGET AUDIENCE

The April 2008 CME article is intended for general/multidiscipline physicians, primary care physicians, hospitalists, pediatricians, and cardiologists, as well as nurse practitioners, physician assistants, nurses, and other medical personnel practicing in Kentucky. The target audience also includes nonmedical persons with a role in public health improvement and policy.

### EDUCATIONAL OBJECTIVES

- 1) Describe the epidemiology and high prevalence of cardiovascular disease in Kentucky.
- 2) Identify the modifiable risk factors associated with cardiovascular disease and understand that lifestyle changes can have a significant impact on the burden of cardiovascular disease in Kentucky.
- 3) Understand that Kentucky has unique social and economic characteristics that must be addressed when planning public health initiatives to combat cardiovascular disease.

- 4) Encourage the reader to advocate for more accessible and comprehensive strategies for cardiovascular risk reduction throughout Kentucky's communities.

### DISCLOSURE

Dr Rugg has nothing to disclose  
 Dr Bailey has nothing to disclose  
 Dr Browning has nothing to disclose

### CREDIT

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*Surveillance System (BRFSS) report of the Centers for Disease Control and Prevention, Kentucky had met none of the stated objectives related to cardiovascular risk for Healthy Kentuckians 2010. Public health initiatives and interventions directed toward the prevention of CVD in Kentucky must address Kentucky's unique challenges if progress is to be made.*

### INTRODUCTION

Cardiovascular disease (CVD), which includes coronary heart disease (CHD), heart failure, hypertension, and stroke, is the leading cause of death for all race and gender groups in the United States.<sup>1</sup> The traditional established risk factors for CVD include age, family history of CVD, high blood pressure, abnormal lipid levels, diabetes, tobacco use, obesity, lack of exercise, low socioeconomic status, and psychosocial stressors.<sup>2</sup> While age and family history are nonmodifiable risk factors, they are estimated to be the primary risk factors in less than 10% of people presenting with an initial acute myocardial infarction (AMI)<sup>3</sup> and in fewer than 20% of those with established CVD.<sup>4,5</sup> This find-

ing suggests that most people with CVD have at least one modifiable risk factor, and thus the vast majority of cardiovascular disease is preventable.<sup>4,5</sup> Hence, control of these risk factors has been the principle approach to primary and secondary prevention of CVD.

Data from the Framingham Heart Study and other epidemiologic investigations have substantiated the increased risk of cardiovascular disease among persons with multiple risk factors.<sup>6-10</sup> The clustering of cardiovascular risk factors results in more than an additive effect. Instead, a synergistic effect exists, with the presence of multiple risk factors conferring a greater likelihood of disease than would be expected from the simple addition of individual risk factors. The associations are complex, but are clearly seen with overweight and obesity, physical inactivity, elevated blood glucose, elevated blood pressure, and abnormal lipid levels.<sup>6-11</sup> Therefore, an integrated approach to risk factor reduction has been advocated in prevention guidelines.

The burden of cardiovascular disease is particularly high in Kentucky. In 2003, the state ranked 6th highest in total cardiovascular disease age-adjusted death rate, 9th highest in

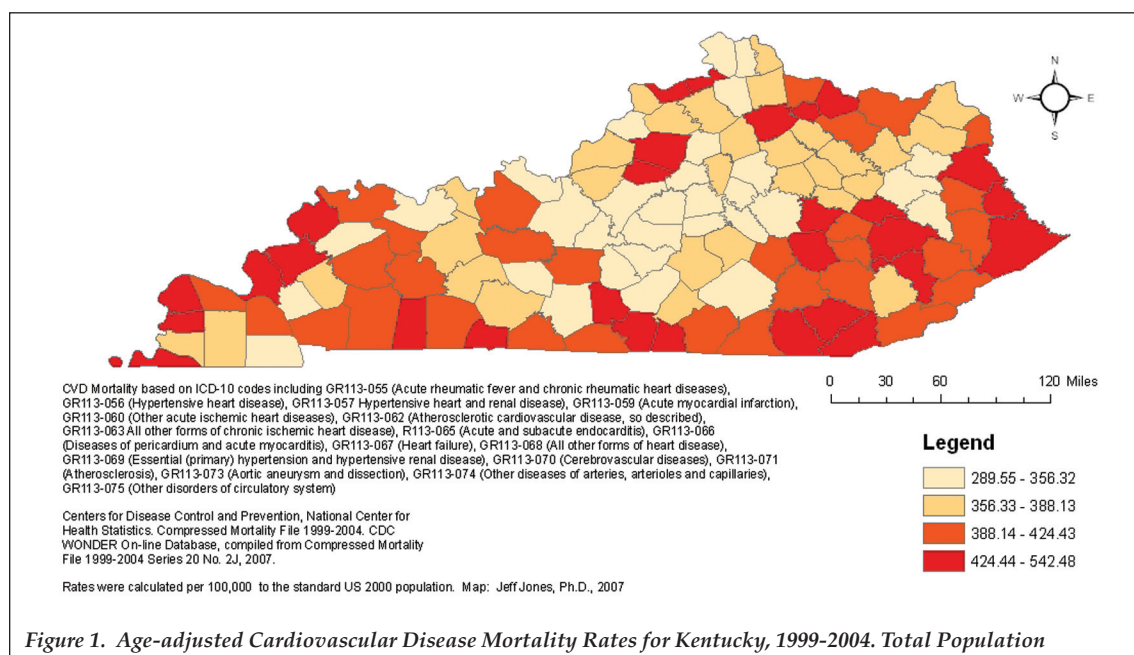


Figure 1. Age-adjusted Cardiovascular Disease Mortality Rates for Kentucky, 1999-2004. Total Population

coronary heart disease age-adjusted death rate, and 10th highest in total stroke age-adjusted death rate.<sup>1</sup> The morbidity and mortality from cardiovascular disease in Kentucky are among the highest in the United States (Figure 1).<sup>12-14</sup>

Kentuckians have the highest prevalence of multiple cardiovascular risk factors in the nation at 46.2% of the adult population.<sup>15</sup> The state ranks 1st for the proportion of the adult population who are current cigarette smokers and 1st for adults who are physically inactive. The prevalence of adult obesity and overweight is 66.4%,<sup>16</sup> ranking the state as 3rd in the United States for these variables combined. These data, however, are averaged across the state and may mask some of the regional disparities in the population. In predominantly rural counties, the risk prevalence may be even higher than in more metropolitan areas of the state.

Kentucky has unique characteristics that contribute to its poor rankings in cardiovascular health. The state's social and economic demographics foster communities that are known to have a clustering of cardiovascular risk factors and tend to be concentrated geographically in the southeastern part of the state. The geographic distribution of cardiovascular diseases in the southeastern United States has led to the designation of the regions adjacent to the Ohio and Mississippi Rivers as the "Coronary Valley." Kentucky has 120 counties, of which 104 are considered rural<sup>17</sup> and 51 are considered part of Appalachia.<sup>18</sup> This region has among the highest rates of cardiovascular disease in the United States.<sup>19</sup> Residents of economically depressed Appalachia are more likely to die from heart disease than residents living elsewhere in the United States, with the highest mortality rates occurring in middle Appalachia—central West Virginia, eastern Kentucky, western Virginia, and northern Tennessee.<sup>12</sup>

In this study, we use recent data to describe the distribution and burden of cardiovascular disease in Kentucky and implications for the planning and design of public health interventions appropriate for this population. Cardiovascular risk factor prevalence is summarized in Table 1. Data were obtained from secondary

sources including the Centers for Disease Control and Prevention Wonder Website for mortality data, the CDC's state-based Behavioral Risk Factor Surveillance System (BRFSS), and the Youth Behavior Risk Surveillance System (YBRSS). Details regarding the collection of the data can be obtained at the CDC Website.<sup>20</sup> The BRFSS is a telephone health survey system tracking at-risk health behaviors in the United States yearly since 1984.<sup>21</sup> The YBRSS is a school-based survey evaluating at-risk health behaviors in students in the 9th through 12th grades.<sup>22</sup>

### *Cigarette Smoking*

Kentucky, a national leader in tobacco production,<sup>23</sup> has consistently ranked as one of top two states in the past decade for the highest proportion of smokers in the population.<sup>21</sup> In the most recent BRFSS data from 2006, 28.5% of Kentuckians were current smokers, compared to 20.1% nationally.<sup>16</sup> During the period from 1985 to 1992, the annual decrease in prevalence of smokers in Kentucky was about 0.6%, a decrease inadequate to meet goals.<sup>24</sup> Since that time, however, smoking rates have leveled out, with smoking prevalence ranging from 27% to 32% since 1990.<sup>16</sup>

In contrast with adults, there have been dramatic declines in youth smoking rates in Kentucky. In 1997, 47% of Kentucky students had smoked within the last month. By 2005, only 26.2% of Kentucky students smoked. While this number is still higher than the national average of 23%, it does represent a significant improvement for Kentucky.<sup>22</sup> A more worrisome observation is that of higher smoking levels in lower income and educated groups. About 38% of Kentuckians below the poverty level smoke, compared with 19% of those earning more than \$50,000 a year.<sup>21</sup> Education level has a particularly strong association with smoking, with 41.5% of adults with less than a high school education smoking, compared to 14.4% of college graduates.<sup>21</sup>

Smoking has numerous detrimental cardiac effects. It induces a hypercoagulable

**Table 1. Prevalence of Cardiovascular Disease Risk Factors for Adults by Gender for Kentucky and the United States. (Behavioral Risk Factor Surveillance System Data from 2005 and 2006).**

Risk Factor (data year)	Males		Females	
	Kentucky % (95% CI)	United States %	Kentucky % (95% CI)	United States %
Current smokers (Adults) (2006)	29.1 (26.1-32.1)	22.2	28.0 (26.0-30.0)	18.4
Weight classification by body mass index (BMI) (2006)				
Overweight (BMI 25.0-29.9)	44.2 (40.9-47.5)	43.7	32.6 (30.4-34.8)	29.5
Obese (BMI 30.0-99.8)	28.2 (25.3-31.1)	25.9	27.9 (25.8-30.0)	24.4
Physician diagnosed diabetes (2006)	11.1 (9.4-12.8)	7.9	8.8 (7.7-9.9)	7.1
High blood pressure (2005)	27.8 (25.4-30.2)	25.4	28.6 (26.9-30.3)	24.9
High cholesterol level (2005)	37.6 (34.5-40.7)	37.3	38.5 (36.4-40.6)	34.2
No physical activity in past month (2006)	27.0 (24.2-29.8)	20.6	33.6 (31.6-35.6)	25.0
Consume < 5 fruits or vegetables per day (2005)	86.5 (84.3-88.7)	81.4	80.0 (78.3-81.7)	71.9

Centers for Disease Control and Prevention (CDC). Behavioral Risk Factor Surveillance System Survey Data. Atlanta, Georgia; US Department of Health and Human Services, Centers for Disease Control and Prevention (2005-2006).

state, causes coronary vasoconstriction, reduces oxygen delivery due to carbon monoxide, accelerates atherosclerosis through damage to the endothelium, and increases fibrinogen levels.<sup>25</sup> In addition, nicotine-related hemodynamic effects occur, with increased blood pressure and heart rate, increased oxygen demand, and arterial constriction. These factors create a particularly lethal combination, with tobacco use being linked definitively to sudden death, myocardial infarction, and stroke.<sup>26</sup> Tobacco use causes a twofold to threefold increase in the risk of death from coronary heart disease.<sup>27</sup> The use of all forms of tobacco increases the risk of cardiovascular diseases, with the magnitude of risk closely related to the number of cigarettes smoked, even at low levels of smoking.<sup>28</sup>

Environmental tobacco smoke, also called passive or secondhand smoke, has also been shown to have deleterious effects. A 2006 report of the U.S. Surgeon General, *The Health Consequences of Involuntary Exposure to Tobacco Smoke*, described a 25% to 30% increase in the risk of coronary heart disease from secondhand smoke exposure.<sup>29</sup> The INTERHEART study found that non-smoking spouses exposed to secondhand smoke had a significantly increased risk of myocardial infarction (OR 1.28, 95% confidence interval 1.12-1.47).<sup>28</sup>

Smoking cessation has appreciable cardiac benefits. The INTERHEART study found that while former smokers had a higher risk of AMI than non-smokers, the risk decreased over time, with much of the excess risk diminished within five years.<sup>28</sup> Light smokers

had no excess risk after 3 to 5 years, though moderate and heavy smokers still had some residual risk, even after 20 years of smoking cessation.<sup>28</sup> Inflammatory markers return to normal 5 years after smoking cessation, suggesting that the inflammatory component of cardiovascular disease associated with smoking is reversible.<sup>30</sup>

### *Overweight & Obesity*

It is well established that elevated body weight is associated with excess morbidity and mortality rates.<sup>31</sup> The most commonly used tool to assess weight and body fat is the body mass index (BMI). Both overweight (BMI of 25.0-29.9) and obesity (BMI>30) are independent risk factors for cardiovascular disease and adversely affect other CVD risk factors, such as LDL and HDL cholesterol levels, triglyceride levels, blood glucose, and blood pressure.<sup>32-34</sup> While there has been a decline in the prevalence of most cardiovascular risk factors over the last 25 years, the prevalence of overweight and obesity has been increasing in all race and gender groups and across all geographic regions and socioeconomic status levels.<sup>35</sup>

Kentucky is no exception. In 2006, the prevalence of obesity was 28%, an increase of more than 130% since 1990, and the prevalence of overweight was 38.4%, an increase from 23.5% in 1990. While both categories are increasing in number, the sharpest rise is seen in the obese subgroup. Although the prevalence of overweight is similar to the national average, Kentucky is above the average for obesity and ranks 3rd in the nation for largest overweight and obese population.<sup>16</sup>

There are differences in the prevalence of overweight and obesity in certain population subgroups that warrant attention. A higher proportion of males are overweight than females, but obesity is similar between the sexes. No racial differences can be elucidated among white, black, or Hispanic males. However, black and Hispanic women are overrepresented in both the overweight and the obese categories.<sup>21</sup> Socioeconomic status seems to

have a paradoxical effect on overweight or obese status. As income and education increase, overweight status parallels the rise but obesity rates decline.<sup>21</sup>

The trend of increasing body mass in adults is paralleled in youths. In 2005, 13.1% of the nation's students were considered overweight, with a body mass index at or greater than the 95th percentile, compared to 10.7% in 1999. In Kentucky 15.6% of students were overweight, with an additional 17% considered at risk for overweight, with a body mass index between the 85th and 95th percentiles. Nationally, 15.7% of students were considered at risk.<sup>22</sup> These rates of youth body mass increase show no signs of slowing, indicating that childhood obesity is likely to continue and contribute to the epidemic of cardiovascular disease.

### *Physical Inactivity*

Physical inactivity contributes to increased all-cause mortality as well as to increased CVD risk and is one of the leading causes of preventable death.<sup>36, 37</sup> The American Heart Association, the US Surgeon General, the Centers for Disease Control and Prevention, and the American College of Sports Medicine recommend at least 30 minutes per day of at least moderate-intensity physical activity on most, and preferably all, days of the week.<sup>38</sup> In 2005, only 34% of Kentuckians reported regular physical activity and only 68% of Kentuckians reported *any* physical activity in the last month. This gives Kentucky the distinction of being the least active state in the nation.<sup>21</sup>

Worrisome trends can be seen in certain population subgroups. Regular physical activity is correlated with income level and education, with those at the lowest income and education levels reporting the least amount of regular physical activity. In addition, low levels of regular physical activity are also seen with increasing age, black or Hispanic race, and distance from a metropolitan area.<sup>31</sup>

Trends in Kentucky students elicit even more concern. In 2005, only 58.7% of students had participated in regular physical activity in

the past week, compared to 68.7% nationally. Females were less physically active than males both in Kentucky and nationwide. The lack of physical activity during the school day contributes to this problem. Only 25.2% of Kentucky students attended even one physical education class per week. The average nationwide was 54.2%, indicating an astonishing disparity between Kentucky and the rest of the country in promoting exercise among youth. Kentucky students, however, watch a heavy amount of television, with 35.5% watching at least 3 hours on an average school day.<sup>22</sup> Lifelong patterns of physical inactivity are initiated in Kentucky's young people, persisting into adulthood with potentially lethal consequences.

### *Diabetes*

Diabetes is considered a CVD risk equivalent, indicating that the risk for a person with diabetes is equivalent to that of persons with an established history of CVD. Diabetics are a high-risk population, requiring aggressive control of other CVD risk factors as well as tight control of blood glucose. Cardiovascular risk and all-cause mortality increase as the level of glucose control decreases.<sup>39</sup>

In 2005, the prevalence of diabetes in Kentucky's population was 9%, compared to 7% nationally. Kentucky ranks 8th in the number of diabetics in the population.<sup>21</sup> Since 1990, the prevalence of diagnosed diabetes in the United States has increased 61% and shows no signs of slowing.<sup>1</sup> Like several other cardiovascular risk factors, the prevalence of diabetes increases with advancing age, lower income, lower educational status, and is positively correlated with black and Hispanic races.<sup>21</sup>

### *Hypertension*

A strong relationship exists between elevated blood pressure and risk of vascular mortality. A meta-analysis of 61 studies evaluating one million people with no prior history of vascular disease showed a strong, direct relationship between blood pressure and vascular mortal-

ity, as well as overall mortality.<sup>40</sup> This effect persisted down to a blood pressure of at least 115/75, with no apparent threshold effect. In adults aged 40-69 years, each increase in systolic blood pressure of 20 mmHg was associated with a two times increase in the risk of death from stroke, as well as a two times increase in the risk of death from ischemic heart disease and other vascular causes.<sup>40</sup>

In 2005, 28.2% of Kentuckians reported awareness of high blood pressure, compared to 25.5% nationwide.<sup>21</sup> These numbers have remained unchanged since 1999, both in Kentucky and nationwide. They may, however, underestimate the number of people with hypertension. Hypertension has few manifestations early in its clinical course, and many people may be unaware of the diagnosis.

### *Abnormal Lipid Levels*

Lipids can be divided into total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), and triglycerides (TG). Elevated LDL cholesterol is a major cause of coronary heart disease (CHD). Likewise, elevated triglycerides and low HDL are independent risk factors for CHD. Conversely, high HDL confers a decreased risk for CHD.

There is strong evidence that LDL-lowering therapy reduces the risk for developing CHD as well as the number of CHD events in those individuals with established disease. Therefore, LDL is the primary target for therapy. The optimal LDL goal for the population is less than 100 mg/dL and should be achieved with therapeutic lifestyle changes (TLC) plus pharmacologic agents, if needed, depending on an individual's risk. Elevated serum triglycerides (>200 mg/dL) and low levels of HDL (<40 mg/dL) should be treated with TLC and the addition of pharmacologic agents, if needed, as secondary goals.<sup>41</sup>

In 2005, the prevalence of high cholesterol in Kentucky was 38%, placing it 9th highest in the nation. The likelihood of an individual having abnormal lipid levels increases with low income, low education, and increasing age.

Whites have higher rates of abnormal lipid levels than either black or Hispanic races, but no gender differences are apparent.<sup>21</sup>

### Ecologic Risk Factors

There are great disparities in coronary heart disease risk among certain population subgroups. Persons with lower educational status, lower household income, or self-described inability to work or unemployed status have a much greater prevalence of multiple CHD risk factors.<sup>1,42</sup> They also tend to have worse clinical status at baseline, higher levels of risk factors, and more comorbidities.<sup>43</sup> In addition, the incidence of ischemic heart disease is inversely related to education, income, and poverty status.<sup>44</sup> Patients with lower socioeconomic status who have cardiac events also have worse outcomes, with a greater mortality rate after an AMI and higher rehospitalization rates.<sup>43</sup>

Kentucky's economic, educational, and social environment is such that a large portion of the population is contained in low socioeconomic subgroups. According to 2005 Census data, 17% of Kentuckians live in poverty. The average per capita income is 80% of the national average. Only 79% of Kentucky's adult population has a high school diploma or equivalent, and only 19% has a bachelor's degree or higher.<sup>45</sup> A full 20% percent of adult non-institutionalized Kentuckians aged 21-64 consider themselves disabled,<sup>46</sup> and an additional 5.7% are unemployed.<sup>47</sup> Of those older than 65, nearly 50% consider themselves disabled.<sup>46</sup>

While Appalachia as a region has an excessive CHD mortality, the more rural and less affluent areas, such as the counties that comprise eastern Kentucky, are at particularly high risk.<sup>12</sup> Figure 2 shows the trends in cardiovascular disease mortality rates for Kentucky from 1979 to 2004, comparing the Appalachian to non-Appalachian counties. While trends in CVD mortality rates in Appalachian counties have paralleled the declines in non-Appalachian counties, the overall rates have been consistently higher. In the most recent decade, the rate of decline in CVD seen in the Appalachian re-

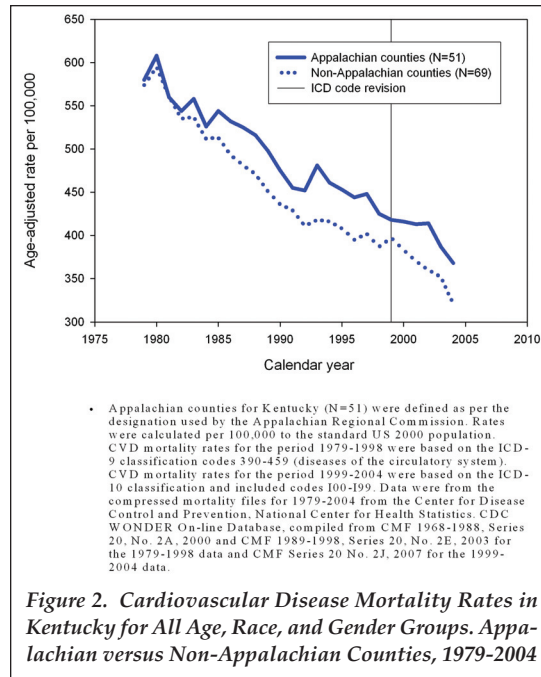


Figure 2. Cardiovascular Disease Mortality Rates in Kentucky for All Age, Race, and Gender Groups. Appalachian versus Non-Appalachian Counties, 1979-2004

gion of Kentucky may be slower than in other parts of the state.

In general, life expectancy for both men and women is lower in Appalachian counties than the United States. National data on CVD mortality trends suggest that a substantial gap exists between the poor and undereducated and the wealthy and educated.<sup>48</sup> This finding places the Appalachian region at high risk, as it is characterized by low levels of urbanization, lower standards of living, higher poverty levels, and less education than the nation as a whole. In addition to fewer economic resources, many Appalachian counties lack the medical care facilities and personnel to treat CHD adequately. This deficiency results in the increasing inequalities seen in CHD mortality between Appalachia and the nation.<sup>49</sup>

### DISCUSSION

Tremendous advances have been made in treating cardiovascular disease. Over the years 1980-2000 in the United States, the mortality rates associated with CHD fell by more than 40%.<sup>50</sup>

The decrease is related to multiple factors including improved interventional techniques, more aggressive medical therapy, and widespread public health campaigns to improve primary and secondary prevention of CVD. In a recent paper, Ford et al quantified how much each variable contributed to the decreases in mortality. Utilizing a mortality model, the authors performed an analysis that yielded several interesting conclusions. The majority of reduction in mortality (72%) can be attributed to preventive strategies; these include secondary preventive therapies after an AMI or revascularization (11%) as well as reductions in total cholesterol (24%), systolic blood pressure (20%), smoking prevalence (12%), and physical inactivity (5%).<sup>50</sup> These decreases were partially offset, however, by diabetes and obesity, which accounted for an 18% increase in deaths.<sup>50</sup>

Over a similar time period, 1979-2004, the total number of inpatient cardiovascular operations and procedures increased 432%.<sup>1</sup> These interventions are costly: for example, in 2003, a coronary artery bypass grafting surgery (CABG) cost, on average, \$83,919. Diagnostic cardiac catheterization cost \$24,893, with a percutaneous intervention costing \$38,203.<sup>1</sup> Revascularization by either CABG or angioplasty, however, accounted for only about 7% of the overall decline in deaths.<sup>50</sup> With ever-mounting data that primary and secondary preventive measures save lives in greater numbers than procedural interventions, health care funding should be targeted toward prevention to gain the greatest mortality benefit.

Despite evidence that prevention has a significant mortality benefit, preventive therapies continue to fall short of goals. The prevalence of cardiovascular risk factors among those who have had cardiac events, as well as those who have not, continues to increase.<sup>4</sup> To date, the United States and Kentucky, in particular, have been unsuccessful in achieving the recommended goals for treatment of lipids, blood pressure and glucose, smoking cessation, weight loss, and increased physical activity on a widespread basis.<sup>51, 52</sup> Only 10% of adults with established CVD have achieved control of

their risk factors, despite public awareness campaigns and the introduction of formal guidelines.<sup>53, 54</sup>

We propose changes in several key areas to address Kentucky's cardiac prevention needs. The state should target smoking cessation, increased physical activity, improvement in diet and nutrition, and cardiac rehabilitation for those with established CHD. A special focus should be placed on Kentucky's youth to establish healthy lifestyle patterns early.

### *Smoking Cessation*

Smoking cessation is an important component in any campaign to reduce cardiac mortality, particularly in Kentucky where tobacco abuse is widespread. With the strength of the tobacco industry in the state, pressure exists to keep taxes on tobacco low. The Federation of Tax Administrators reported data for state excise tax rates on cigarettes from January 1, 2007, showing that Kentucky has a comparatively low 30 cents per pack tax rate on cigarettes, ranking the state 46th for cigarette taxes.<sup>55</sup> A study of cigarette purchase patterns in four countries, including the United States, showed that those who purchased low tax or untaxed cigarettes were less likely to make quit attempts or to quit successfully.<sup>56</sup> An analysis of tobacco company documents revealed that price has a significant impact on cigarette smoking, with higher taxes resulting in a reduction in smoking.<sup>57</sup> Tax increases seem to affect minorities and lower-income populations more than other groups.<sup>58</sup> In addition, young adults also tend to be more sensitive to cigarette price, with higher cigarette prices reducing the probability of youth smoking.<sup>59</sup> It has been estimated that a 50% price increase could result in a 12.5% decrease in US cigarette consumption.<sup>58</sup> Kentucky should consider increasing the tax on cigarettes and other forms of tobacco to reduce smoking in the state, particularly among youth.

Smoking in the workplace is also a problem in Kentucky businesses. Hahn et al found that most manufacturing facilities in Kentucky

allowed indoor smoking and few helped smokers quit.<sup>60</sup> This finding is disturbing, especially with data suggesting that smoke-free workplaces reduce the prevalence of smoking and the number of cigarettes smoked, reducing total cigarette consumption by 29%.<sup>61</sup> Kentucky's legislature should consider prohibiting smoking in the workplace.

Recently, smoking bans have been initiated in several cities nationwide, as well as in several Kentucky counties. Early reports suggest that smoke-free ordinances may be successful in improving cardiovascular outcomes. Sargent et al examined Helena, Montana, prior to and following the institution of a smoke-free ordinance. They found a statistically significant decrease in the number of admissions for AMI during the time period studied.<sup>62</sup> In another study, Bartecchi et al examined admission rates for AMI within the city limits of Pueblo, Colorado, for 1½ years prior to and 1½ years following the initiation of a smoke-free ordinance. They also compared the city to El Paso County, Colorado, a community without a smoking ban, as an external control. They found a significant decrease in the number of admissions for AMI within Pueblo following the smoking ban, with no corresponding decrease outside the city limits or in the control community.<sup>63</sup> While results from these recent studies should be interpreted with some caution as they involve small numbers and do not closely evaluate changes in smoking behavior among individuals, smoke-free ordinances do seem to hold promise in improving cardiovascular outcomes.

One concern about smoke-free ordinances is that they may harm the economy of businesses in the area. Lexington was the first Kentucky community to become smoke-free, instituting a smoking ban in April 2004. Pyles et al evaluated the effect of the ban on employment and restaurant closures, by comparing the time periods before and after the ban went into effect. They found an increase in employment in restaurants, but no change in employment in bars. There was no significant difference in the rate of restaurant closures before and after the institution of the ordinance.<sup>64</sup> Data for Lexington

were consistent with data from other communities around the nation with smoking bans, such as New York City, New York, and El Paso, Texas, showing no detrimental economic effect in the measured outcomes.<sup>65,66</sup> With early data showing promise that smoking bans may decrease cardiovascular morbidity without causing economic harm, smoke-free ordinances may represent a critical policy approach for reducing the risk of CHD.

Comprehensive anti-smoking programs have been effective in other states. Fichtenberg and Glantz describe the California Tobacco Control Program, a large, aggressive campaign involving an increased cigarette tax with allocation of a portion of the tax revenue to an anti-tobacco educational program. After the initiation of the program, the rates of decline in cigarette consumption and cardiac mortality were significantly greater than the pre-1989 rates of decline. The program was associated with 33,300 fewer deaths from heart disease between 1989 and 1997 than would otherwise have been expected during that time period based on earlier mortality trends.<sup>67</sup> In New York City, a comprehensive program including taxation, smoking cessation services, provider education, and a media campaign resulted in a decrease in adult smoking prevalence from 21.5% to 18.4% from 2002 to 2004.<sup>68</sup>

For Kentucky to be successful in reducing smoking prevalence, a comprehensive approach must be undertaken. Excise taxes on cigarettes must be raised, with a portion of the revenue dedicated to funding education for smokers and healthcare providers, smoking cessation programs, and an anti-smoking media campaign directed at children and adults. Workplaces should be smoke-free, and smoke-free ordinances in communities as a whole should be considered.

### *Physical Inactivity and Nutrition*

While smoking is a major problem in Kentucky, the state confronts other challenges as well. Kentucky needs a comprehensive program to address the risk factors of poor nutrition and physical inactivity to halt the growing obesity

epidemic. Educational materials such as posters and pamphlets have had only limited success because they do not address the problem many Kentuckians have in accessing healthy lifestyle choices.

Rurality, particularly in Appalachia, affects many aspects of a healthy lifestyle, including food choices. Fresh produce such as fruits and vegetables is costly and often unavailable. Government subsidies for grocery stores or food vouchers should be considered as a way to encourage healthier food choices. The food stamp system could be modified to allow greater purchasing power for healthier items among those receiving government assistance. Nutrition classes should be offered at the community level to teach people to make healthy food choices and to instruct them in preparation of those foods. Co-ops are another option for communities to have improved access to fresh produce.

Exercising can also be difficult in rural areas. Walking for exercise is an excellent choice for cardiovascular health, but many rural Kentuckians do not have access to safe places to walk because they live near rural highways without sidewalks. Community centers should be available with exercise facilities and walking tracks in areas that are easily accessible to Kentuckians.

A wry observer once noted, "Knowledge is power, but it is not willpower." Comprehensive and successful approaches to behavior change, like the Cooper Clayton method of smoking cessation developed by researchers at the University of Kentucky, employ not only education but also social support and skills training. Another example of an interactive program that goes beyond mere education is the University of Kentucky's Healthtrac Rewards program, by which employees may reduce their health plan costs by participating in wellness activities. These types of novel incentive programs could be adapted for many populations throughout Kentucky.

These efforts must start at the elementary school level. Kentucky has already begun to make positive changes in this area. Senate Bill 172 was passed by the Kentucky General

Assembly in 2005, establishing nutrition requirements regulating the types of food sold in schools, when food can be sold, and developing guidelines for vending machines and soft drinks. Physical activity guidelines were also initiated, ensuring that children in public schools have at least 30 minutes of physical activity per day. School districts are now required to have written wellness plans. Based on these changes, the Center for Science in the Public Interest rated Kentucky highest in the nation in 2006 for its school nutrition policy.<sup>69</sup> These measures are a step in the right direction in teaching children to make healthy lifestyle choices, but we must go even further and allocate resources that will allow Kentuckians to continue to make good decisions in the school years and beyond.

### *Cardiac Rehabilitation*

Cardiac rehabilitation programs afford an impressive 15% to 28% reduction in all-cause mortality and a 26% to 31% reduction in cardiac mortality.<sup>70</sup> These programs offer a comprehensive approach to diet and exercise education for patients with cardiovascular disease, as well as facilities for monitored, medically directed exercise. Unfortunately, these programs are vastly underutilized in Kentucky, with only about 13% of Kentuckians who are likely to benefit from cardiac rehabilitation attending any sessions. Not surprisingly, utilization rates of cardiac rehabilitation parallel income and education levels, with the lowest utilization rates in the lower socioeconomic groups.<sup>70</sup> While there are more than 100 cardiac catheterization laboratories in Kentucky, there are only 60 cardiac rehabilitation programs, and only 16 of those are in Appalachian counties.<sup>71</sup> Distance to the nearest cardiac rehabilitation program is highly reflective of utilization, with those living more than 30 miles away having the lowest rates of use.<sup>70</sup> Resources must be redirected to fund preventive strategies such as cardiac rehabilitation and improve its availability in the state to see continued improvement in cardiac mortality.

SUMMARY

Kentucky faces tremendous challenges in decreasing CVD prevalence. In the 2004 BRFSS report, Kentucky had met none of the stated objectives related to cardiovascular risk for Healthy Kentuckians 2010.<sup>72</sup> In addition, Kentucky's children show disturbing increases in cardiovascular risk factors, especially obesity and diabetes. The cultural legacy of the state with respect to tobacco production, coal-mining dependent local economies, poverty, disability, unemployment, and low levels of education has resulted in a disproportionate burden of cardiovascular disease. This burden particularly affects the poor and undereducated. Previous approaches to targeting risk factor prevention may have neglected these at-risk populations. Future measures must take into account Kentucky's distinctive social and economic milieu.

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# JOURNAL CME

*Journal of the Kentucky Medical Association*

## CME Test Questions

*(Please record your answers on the CME Registration and Answer Form.)*

**Question 1:**

True or False: Kentuckians have the highest prevalence of multiple cardiovascular risk factors in the nation.

**Answer:**

True/False            True    False

**Question 2:**

Traditional risk factors for cardiovascular disease include all of the following except:

- Answer:**            (A) Tobacco Abuse  
*Multiple Choice*    (B) Obesity  
                          (C) Atrial fibrillation  
                          (D) High blood pressure

**Question 3:**

True or False: Over the last 25 years, the prevalence of overweight and obesity in Kentucky has declined.

**Answer:**

True/False            True    False

**Question 4:**

Factors placing the Appalachian region at increased risk for cardiovascular mortality include all of the following except:

- Answer:**            (A) High poverty levels  
*Multiple Choice*    (B) Well water  
                          (C) Lower education levels  
                          (D) Decreased access to medical facilities

**Question 5:**

True or False: It is estimated that only 10% of adults with cardiovascular disease have achieved control of their risk factors.

**Answer:**

True/False            True    False

**Question 6:**

True or False: Cardiac rehabilitation programs have been found to have a 26 to 31% reduction in cardiac mortality.

**Answer:**

True/False            True    False

*Journal of the Kentucky Medical Association*

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# KENTUCKY'S ORAL HEALTH INDICATORS AND PROGRESS TOWARDS HEALTHY PEOPLE 2010 OBJECTIVES

Amit Chattopadhyay, PhD, MPH, MDS; Oscar Arevalo, DDS, ScD, MBA; James C. Cecil III, DMD, MPH

**Objectives:** National and Kentucky (KY) state-specific oral health indicators were compared to Healthy People (HP) 2010 oral health objectives to assess the progress of the state. **Methods:** Oral health surveillance system—derived estimates from national and KY surveys for various oral health indicators (1999-2004) were examined and compared with national estimates and the HP 2010 objectives. The null hypothesis that differences between national and KY indicators did not differ significantly was statistically evaluated using a “z” statistic-based test. **Results:** About 99.7% of KY had water fluoridation, ranking 2nd highest in the US. KY ranked 24th in the US for adult dental visits (69.8% people with a dental visit compared to national average of 69%). Some 38% of the elderly population was edentulous (national, 20.5%). Compared to other states, KY ranked high for teeth cleaning and dental sealants, but had greater caries experience and untreated caries among children. These patterns remained even in socio-demographic factor subgroup analysis. Most of these indicators improved from 1998 to 2004. **Conclusions:** KY oral health indicators as documented by state/regional oral health surveys are not encouraging, and the progress towards the HP 2010 objectives is quite limited. Despite major national emphasis on oral health improvement and better than national average annual dental visit for some segments of the population, KY has a very high prevalence of edentulism compared to the rest of the country. Educated policy making and additional resources for program planning and implementation are required to improve the oral health status of KY residents.

## INTRODUCTION

Historically, Kentucky (KY) has been characterized as a poor, rural state with high health disparities and poor oral health. Although prevalence of oral disease is high, few publications

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have documented the extent of oral diseases in KY. A comprehensive literature search in PubMed using key words “dental + Kentucky” returned 205 articles, whereas “oral + health + Kentucky” returned 40 articles, of which 20 were duplicates included in the previous search return yield between year 1965 and 2006. None of these articles assessed oral health determinants in KY completely, established population-based estimates, or provided a comprehensive description of oral health status among adults in KY. Furthermore, the National Oral Health Surveillance System (NOHSS) data sources were not used either. Established in 2001, NOHSS is a collaborative effort between the Centers for Disease Control (CDC) Division of Oral Health and the Association of State and Territorial Dental Directors (ASTDD), designed to monitor the burden of oral disease, the use of the oral health care delivery system, and the status of community water fluoridation on both a national and state level.<sup>1</sup> NOHSS includes indicators of oral health, information on state dental programs, and links to other important sources of oral health information.

This analysis intends to assess KY's current oral health status and its progress towards the national benchmarks established in Healthy

People 2010, the national health promotion and disease prevention initiative.

### MATERIALS AND METHODS

Information from the KY Cabinet for Health and Family Services and from the NOHSS was collected. NOHSS-derived estimates from national surveys were examined to obtain KY-specific estimates for various oral health indicators (1999-2004) and these were compared with national estimates and the 2010 objectives. Released in 2001, the NOHSS emphasizes state-based data tracking eight basic oral health indicators: dental visits, teeth cleaning, complete tooth loss, loss of 6 or more teeth, fluoridation status, dental sealants, caries experience, untreated tooth decay, and cancer of the oral cavity and pharynx. The Council of State and Territorial Epidemiologists (CSTE) and the Association of State and Territorial Chronic Disease Program Directors (ASTCDPD) developed the framework for chronic disease surveillance indicators, including these oral health indicators.<sup>2</sup>

Data for dental visits (ages 18 years and older), and tooth loss (ages 65 years and older) were collected from the National Health Interview Survey (NHIS) and the Behavioral Risk Factor Surveillance System (BRFSS). Tooth loss proportions were extracted from the KY adult oral health survey<sup>3</sup> and the KY Elderly Oral Health Survey.<sup>4</sup> Data on teeth cleaning (ages 18 years and older) were captured from BRFSS. Fluoridation status for the 50 states and the District of Columbia was collected from the Water Fluoridation Reporting System (WFRS, year 2000). Sealants and caries indicators were included from state oral health surveys.<sup>2</sup>

The information available for KY was aggregated and compared with other states to determine KY's ranking nationally. Where possible, we statistically evaluated the null hypothesis that differences between national and KY averages did not differ significantly by subtracting the national mean from the KY mean and dividing the difference by the pooled standard error yielding a "z" statistic-based test<sup>5</sup>

and tested for general association using chi-square tests where appropriate. The 2004 KY data for trends within categories were tested using the Cochran–Armitage test to assess a possible monotonic dose-response type of trend in age and education and income level categories for the measured parameters. The null hypothesis for the Cochran–Armitage test was that the trend was linear. Thereafter the current status for available indicators was compared against the projected national goals for Healthy People 2010 objectives<sup>6</sup> and the Healthy People 2010 mid-course review.<sup>7</sup> All analyses were conducted using SAS<sup>®</sup> (PC, V 9.1).

### RESULTS

#### *Overall Comparison of KY to Previous Years and to National Average*

Table 1 provides a global comparison of the status of access to oral health care and oral health indicators for KY and national estimates. Access to oral health care, defined as a visit to a dentist in the past one year, for KY was about the same as the national average. Although KY ranked about mid-way in the nation, it ranked substantially below Connecticut at 79.3%. The proportion of people having their teeth cleaned in the past year was substantially higher in KY than the national average, ranked 15th in the nation, although substantially below Connecticut at 79.1%.

KY ranked 2nd highest in the nation for proportion of adults 65 years or older who have lost all of their natural teeth due to tooth decay or gum disease (highest: West Virginia at 42.9%); and had the third highest proportion of adults aged 65 years or more who have lost 6 or more teeth due to tooth decay or gum disease (highest: West Virginia at 69.6%). Utah had the minimum proportions in these categories in the nation (at 13.6% and 32.6%, respectively). Compared to 1999 and 2002 estimates, KY exhibited some improvement in 2004 for each of these attributes in a dose-response manner. KY continued to be among the top states (2nd in the

**Table 1.** Changes in estimates oral health attributes of Kentucky residents (adults and children) over the years for which data is available for US or states. Source: National Oral Health Surveillance System.

Oral Health Measure	US-2004	KY-2004	2004		
			National rank	KY-2002	KY-1999
Adults aged 18+ who have visited a dentist or dental clinic in the past year	69.00%	69.80%	24th highest/52	67.30%	63.00%
Number of people having teeth cleaned in the past one year	69.00%	73.30%	15th highest/52	70.60%	68.30%
Adults aged 65 years+ who have lost all of their natural teeth due to tooth decay or gum disease	20.50%	38.10%	2nd highest/52	42.50%	44.20%
Adults aged 65 years+ who have lost six or more teeth due to tooth decay or gum disease	45.9	58.9	3rd highest/52	64.10%	71.20%
Percentage of 3rd grade students with dental sealants on at least one permanent molar tooth	NA	28.80%	14th highest/23	NA	NA
Percentage of 3rd grade students with caries experience (treated or untreated tooth decay)	NA	59.80%	9th highest/23	NA	NA
Percentage of 3rd grade students with untreated tooth decay	NA	34.60%	5th highest/23	NA	NA
	US 2002	KY 2002	2002		
			National rank	KY 2000	KY 1992
Population on public health water supply system receiving fluoridated water	67.30%	99.70%	2nd highest/52	96.10%	100.00%

nation, behind District of Columbia—100%) for fluoridated water supply, with 99.7% coverage in 2002 (last available data in NOHSS).

National estimates or estimates from all states were not available in NOHSS for several oral health indicators related to children’s caries experience. Comparisons of these indicators were restricted to only the 23 states for which data were available. Therefore, comparison with a national estimate was not possible; rankings reflect comparisons between states for which data were available (Table 1). KY ranked high in the nation for children with total caries experience (KY: 60%, rank 9th compared to California, being highest at 70.9%, and Maryland lowest at 42.4%) as well as with untreated caries experience (KY: 35%, rank 5th; Arizona highest at 39.4%, and Vermont lowest at 16.2%). KY ranked mid-way for proportion of 3rd grade students with sealants on at least one permanent molar tooth (KY: 29%, rank 14th compared to Vermont, being highest at 66.1%, and South Carolina lowest at 20.3%).

*Socio-economic Group-specific Comparisons to National Figures*

Table 2 compares national and KY estimates for oral health indicators by age, education level, sex, income, and race/ethnicity of residents. Whereas a larger proportion of individuals between 18-44 years of age in KY reportedly visited a dentist in the past one year, a smaller proportion among those 45 years or older reported such visits, compared to national estimates. A smaller proportion of Kentuckians with less than high school education visited a dentist compared to the national average (opposite outcome among those with more education). Although there were not many differences in visits to dentist by sex, an income effect could be discerned—a greater proportion of Kentuckians with annual income higher than \$25,000 visited a dentist compared to the national average. Although data were not available for Kentuckians across all racial/ethnic groups, compared to national estimates, more

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**Table 2.** Estimates (95% CI) oral health attributes related to system utilization, teeth cleaning, and tooth loss of Kentucky residents in 2004 across socio-demographic factors, compared to national estimates (BRFSS 2004 data) for which data are available. Source: National Oral Health Surveillance System (unless stated otherwise).

Criteria	Socio-demographic criteria	Levels	US	KY	
<b>Dental Visit (in the past one year)</b>	<b>Overall</b>		69.0 (68.7, 69.3)	69.8 (68.0, 71.6)	
	<b>Age (years)</b>	18-24	67.6 (66.3-68.9)	82.2 (76.1-88.3)	
		25-34	66.1 (65.2-67.0)	72.9 (68.3-77.5)*	
		35-44	70.0 (69.3-70.7)	72.9 (68.8-77.0)	
		45-54	72.5 (71.8-73.2)	69.7 (66.1-73.3)	
		55-64	71.4 (70.6-72.2)	64.6 (60.7-68.5)*	
		65+	66.1 (65.4-66.8)	56.6 (53.1-60.1)*	
		<b>Education</b>	Less than H.S.	47.0 (45.8-48.2)	41.6 (37.4-45.8)*
			H.S. or G.E.D.	64.3 (63.7-64.9)	68.8 (65.9-71.7)*
			Some post H.S.	71.4 (70.7-72.1)	77.9 (74.4-81.4)*
			College graduate	80.0 (79.5-80.5)	80.7 (77.1-84.3)
		<b>Sex</b>	Male	66.8 (66.2-67.4)	68.4 (65.5-71.3)
			Female	71.1 (70.7-71.5)	71.0 (68.9-73.1)
		<b>Annual Income</b>	Less than \$15,000	50.0 (48.7-51.3)	49.7 (44.7-54.7)
			\$15,000-\$24,999	55.4 (54.5-56.3)	55.2 (50.5-59.9)
			\$25,000-\$34,999	65.0 (64.0-66.0)	70.1 (65.3-74.9)*
			\$35,000-\$49,999	71.1 (70.3-71.9)	74.7 (70.2-79.2)
			\$50,000+	81.4 (80.9-81.9)	86.4 (83.5-89.3)*
		<b>Race/ Ethnicity</b>	White	72.4 (72.1-72.7)	70.0 (68.2-71.8)*
			Black	62.0 (60.9-63.1)	67.5 (58.9-76.1)
		Hispanic	59.1 (57.8-60.4)	N/A	
		Other	67.1 (65.1-69.1)	N/A	
		Multi-racial	59.9 (56.8-63.0)	N/A	
<b>Teeth Cleaning (in the past one year)</b>	<b>Overall</b>	69.0 (68.6-69.4)	73.3 (71.4-75.2)*		
	<b>Age (years)</b>	18-24	66.2 (64.9-67.5)	83.4 (78.3-88.5)*	
		25-34	64.0 (63.1-64.9)	71.6 (66.9-76.3)*	
		35-44	68.2 (67.5-68.9)	71.7 (67.4-76.0)	
		45-54	71.0 (70.3-71.7)	70.5 (66.7-74.3)	
		55-64	73.3 (72.5-74.1)	73.3 (69.4-77.2)	
		65+	73.1 (72.3-73.9)	72.7 (68.8-76.6)	
		<b>Education</b>	Less than H.S.	48.9 (47.5-50.3)	49.6 (44.0-55.2)*
			H.S. or G.E.D.	63.7 (63.0-64.4)	71.4 (68.3-74.5)*
			Some post H.S.	70.2 (69.5-70.9)	77.2 (73.7-80.7)
			College graduate	79.2 (78.7-79.7)	81.5 (77.9-85.1)
		<b>Sex</b>	Male	66.4 (65.8-67.0)	70.6 (67.5-73.7)*
			Female	71.4 (71.0-71.8)	75.8 (73.6-78.0)*
		<b>Annual Income</b>	Less than \$15,000	49.9 (48.4-51.4)	53.3 (47.1-59.5)
			\$15,000-\$24,999	55.0 (54.0-56.0)	58.2 (53.2-63.2)
			\$25,000-\$34,999	64.1 (63.0-65.2)	70.6 (65.5-75.7)*
			\$35,000-\$49,999	69.8 (68.9-70.7)	75.0 (70.4-79.6)*
			\$50,000+	80.5 (80.0-81.0)	87.3 (84.5-90.1)*
		<b>Race/ Ethnicity</b>	White	72.5 (72.1-72.9)	73.5 (71.6-75.4)
			Black	59.7 (58.5-60.9)	67.7 (57.7-77.7)
		Hispanic	60.3 (58.9-61.7)	N/A	
		Other	66.8 (64.7-68.9)	N/A	
		Multi-racial	57.1 (53.8-60.4)	N/A	
<b>Loss of at Least One Tooth**</b>	<b>Age (Years)</b>	18-64	N/A	50%	
		65+	N/A	70.4%	

— Continued next page

Table 2. Continued

Criteria	Socio-demographic criteria	Levels	US	KY
Complete Tooth Loss	Overall		20.5 (19.9-21.1)	38.1 (34.8-41.4)*
	Education	Less than H.S.	41.1 (39.3-42.9)	66.2 (61.1-71.3)*
		H.S. or G.E.D.	23.2 (22.2-24.2)	32.2 (27.1-37.3)*
		Some post H.S.	15.0 (14.0-16.0)	20.0 (14.4-25.6)
		College graduate	7.1 (6.3-7.9)	16.9 (9.1-24.7)*
	Sex	Male	18.8 (17.9-19.7)	33.1 (27.4-38.8)*
		Female	21.7 (21.0-22.4)	41.6 (37.7-45.5)*
	Annual Income	Less than \$15,000	35.9 (33.9-37.9)	53.6 (46.2-61.0)*
		\$15,000-\$24,999	25.3 (24.0-26.6)	44.4 (36.8-52.0)*
		\$25,000-\$34,999	18.6 (17.0-20.2)	27.2 (18.0-36.4)
		\$35,000-\$49,999	11.8 (10.4-13.2)	16.0 (7.9-24.1)
		\$50,000+	6.7 (5.8-7.6)	9.6 (4.4-14.8)
	Race/ Ethnicity	White	19.4 (18.8-20.0)	37.0 (33.6-40.4)*
		Black	28.6 (25.8-31.4)	N/A
Hispanic		21.6 (18.0-25.2)	N/A	
Other		19.8 (15.0-24.6)	N/A	
Multi-racial		27.5 (21.7-33.3)	N/A	
Loss of 6 or More Teeth	Overall		45.9 (45.2-46.6)	58.9 (55.3-62.5)*
	Education	Less than H.S.	68.1 (66.3-69.9)	84.0 (80.1-87.9)*
		H.S. or G.E.D.	51.6 (50.4-52.8)	54.0 (48.1-59.9)*
		Some post H.S.	40.8 (39.3-42.3)	45.4 (37.2-53.6)
		College graduate	27.1 (25.8-28.4)	N/A
	Sex	Male	44.9 (43.7-46.1)	55.8 (49.3-62.3)*
		Female	46.6 (45.7-47.5)	61.0(57.0-65.0)*
	Annual Income	Less than \$15,000	64.4 (62.3-66.5)	75.7 (68.3-83.1)*
		\$15,000-\$24,999	54.5 (52.9-56.1)	66.6 (59.5-73.7)*
		\$25,000-\$34,999	45.9 (43.9-47.9)	N/A
		\$35,000-\$49,999	37.0 (35.0-39.0)	N/A
		\$50,000+	25.8 (24.2-27.4)	N/A
	Race/ Ethnicity	White	43.9 (43.2-44.6)	58.0 (54.3-61.7)*
		Black	64.6 (61.4-67.8)	N/A
Hispanic		47.0 (42.6-51.4)	N/A	
Other		45.6 (38.1-53.1)	N/A	
Multi-racial		56.8 (50.1-63.5)	N/A	

\*Statistically significantly different from US national average estimates.

N/A: Data not available

\*\*KY Adult Oral Health Survey, 2002 & KY Elder Oral Health Survey, 2005

blacks and fewer whites visited a dentist in the past one year.

The pattern seen among adults reporting having their teeth cleaned in the past one year was somewhat different. The proportion of Kentuckians reporting teeth cleaning was higher than the national average for those aged 18-44 years. However, the proportions were similar for older adults. The proportion of Kentuckians who

had teeth cleaning in the past one year was higher than the national average for all education levels. More men and women reported teeth cleaning similar to the national average. A greater proportion of adult Kentuckians had complete tooth loss and 6 or more teeth lost due to caries and periodontal disease compared to the national average. This observation was true across all categories for which data were available.

**Table 3.** Trends in oral health measurable parameters in Kentucky (P = p-value for trend; OR = Odds ratio).

Factor	Levels	Visited dentist in past one year		Teeth cleaning in past one year		Lost at least one tooth		Complete tooth loss	Lost 6 or more teeth
		P	OR	P	OR	P	OR		
Age (years)	18-24	0.00007	<b>1.00</b>	0.18522	<b>1.00</b>	0.004	<b>1.00</b>		
	25-34	0.00007	0.59	0.18522	0.53	0.004	<b>1.00</b>		
	35-44	0.00007	0.59	0.18522	0.53	0.004	<b>1.00</b>		
	45-54	0.00007	0.51	0.18522	0.48	0.004	<b>1.00</b>		
	55-64	0.00007	0.41	0.18522	0.55	0.004	<b>1.00</b>		
	65 or more	0.00007	0.29	0.18522	0.55	0.004	2.33		
Education*	Less than H.S.	<0.00001	<b>1.00</b>	<0.00001	<b>1.00</b>	<0.00001	<b>1.00</b>	<0.00001	<b>1.00</b>
	H.S. or G.E.D.	<0.00001	3.07	<0.00001	2.45	<0.00001	0.24	<0.00001	0.22
	Some post H.S.	<0.00001	4.90	<0.00001	3.35	<0.00001	0.13	<0.00001	0.16
	College graduate	<0.00001	5.89	<0.00001	4.32	<0.00001	0.11	<0.00001	N/A
Annual Income	Less than \$15,000	<0.00001	<b>1.00</b>	<0.00001	<b>1.00</b>	<0.00001	<b>1.00</b>	N/A	N/A
	\$15,000-\$24,999	<0.00001	1.22	<0.00001	1.22	<0.00001	0.67	N/A	N/A
	\$25,000-\$34,999	<0.00001	2.33	<0.00001	2.17	<0.00001	0.32	N/A	N/A
	\$35,000-\$49,999	<0.00001	3.00	<0.00001	2.66	<0.00001	0.16	N/A	N/A
	\$50,000 or more	<0.00001	6.14	<0.00001	5.93	<0.00001	0.09	N/A	N/A

\* H.S. = High school; G.E.D. = General Education Development test

### Trends within KY

Table 3 presents the linear trend analysis for oral health attributes among Kentuckians in 2004. Except for proportion reporting teeth cleaning in the past year by age group, all other linear trends were statistically significant.

**Age:** Compared to the youngest, the odds of visiting a dentist in the past year decreased monotonically with increasing age. A similar trend was observed for reported teeth cleaning in the past year, although it was not statistically significant. A similar trend was noted for tooth-loss variables with age. However, directions of these trends were different in KY compared to the general trend in the US (Fig. 1).

**Education:** Self-reported visits to the dentist and teeth cleaning in the past year increased monotonically with increasing education accomplishments of Kentuckians. College graduates were almost six-times more likely to have visited a dentist in the past year compared to those with less than high school education. Similarly, those with graduate education were almost four and one-half times

more likely to have their teeth cleaned in the past year. A reverse trend was noted for tooth-loss variables. Those with higher education were less likely to have either complete tooth loss or having lost 6 or more teeth due to caries or gum diseases.

**Income:** Trends seen for education were also seen for annual income categories. Ken-

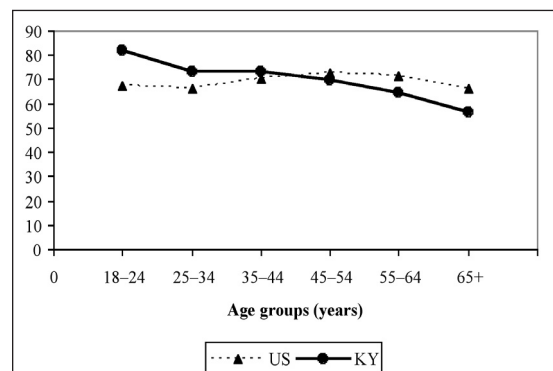


Figure 1. Trend for dental care system utilization in the US and KY. The points represent the mid-point of bars representing the proportion of persons reporting having visited a dentist in the past one year by age groups.

**Table 4. Kentucky progress towards Healthy People 2010 objectives.\***

Objective Number	2010 Objective	Target	KY Status	Goal Met for KY?
21-1b	Reduce proportion of children with dental caries experience in their primary and permanent teeth	42%	59.8%	No
21-2b	Reduce proportion of children with untreated dental decay in their primary and permanent teeth	21%	34.6%	No
21-4	Reduce the proportion of older adults who have had all their natural teeth extracted.	20%	38.1%	No
21-8a	Increase the proportion of children who have received dental sealants on their molar teeth. (children aged 8-years)	50%	28.8%	No
21-9	Increase the proportion of the U.S. population served by community water systems with optimally fluoridates water	75%	99.7%	Yes
21-10	Increase the proportion of children and adults who use the oral health care system each year	56%	69.8% adults 74.5% children (12)	Yes **
21-13	(Developmental) increase the proportion of school-based health centers with an oral health component.	None	No	
21-14	Increase the proportion of local health departments and community-based health centers, including community migrant, and homeless health centers that have an oral components.	75%	3/ 57 HDs; 5/13 FQHCs & CHCs; 0 Migrant centers; 1/1 Homeless centers	No
21-15	Increase the number of states and the District of Columbia that have a system for recording and referring infants and children with cleft lips, cleft palates, and other craniofacial anomalies to craniofacial anomaly rehabilitative teams.		Present	Yes
21-16	Increase the number of states and the District of Columbia that an oral and craniofacial health surveillance system.		Present	Yes
21-17	(Developmental) Increase the number of Tribal, State (including D.C.), and local health agencies that have in place an effective dental public health program directed by a dental professional with public health training.		One—State Dental Department	No

\*Oral health status related to the following HP 2010 objectives could not be measured. 21-1a: Reduce the proportion of young children with dental caries experience in their primary teeth. 21-1c: Reduce the proportion of adolescents with dental caries experience in their permanent teeth. 21-2a: Reduce the proportion of young children with untreated dental decay in their primary teeth. 21-2b: Reduce the proportion of children with untreated dental decay in their primary teeth and permanent teeth. 21-2c: Reduce the proportion of adolescents with untreated dental decay in their permanent teeth. 21-2d: Reduce the proportion of adults with untreated dental decay. 21-3: Increase the proportion of adults who have never had a permanent tooth extracted because of dental caries or periodontal disease. 21-5a: Reduce gingivitis. 21-5b: Reduce destructive periodontal disease. 21-6: Increase the proportion of oral and pharyngeal cancers detected at the earliest stage. 21-7: Increase the proportion of adults who, in the past 12 months, report having had an examination to detect oral and pharyngeal cancers. 21-8b: Increase the proportion of adolescents aged 14 years who have received dental sealants on their molar teeth. 21-11: Increase the proportion of long-term care residents who use the oral health care system each year. 21-12: Increase the proportion of low-income children and adolescents who received any preventive dental service during the past year.

\*\*Data for children not available

tuckians who were college graduates were six times more likely to have visited a dentist and to have had their teeth cleaned in the past year compared to those with less than high school education. Complete tooth loss among those in the highest income group was almost ten times less than those in the lowest income group.

### Healthy People 2010 Objectives

The Healthy People 2010 oral health objectives are detailed in Table 4. As seen in Table 4, KY has not reached close to the Healthy People 2010 objectives except in four of the eleven measurable objectives for which data were available—community water fluoridation (objective

# 21-9), proportion of residents using the oral health care system each year (objective # 21-10), birth defect registry (objective # 21-15), and oral health surveillance system (objective # 21-17).

### DISCUSSION

Progress towards reaching the HP 2010 oral health goals has been uneven for KY. At this time-point, KY met four of the eleven measured goals for which data were available that relate to Kentuckians' oral health status as well as system-level goals for the state. Statistics from the NOHSS data are derived from cross-sectional surveys, and as presented, are not adjusted for potential confounders. However, our goal was not to establish independent risk factors/indicators for measurable outcomes, but to conduct a mid-course evaluation in progress towards Healthy People 2010 goals so that the state can reassess strategies, priorities, and resources in an effort to reach the goals. Therefore, although some trends are noted across levels of categories, we refrain from making causal inferences. For example, we do not state that higher income caused more people to visit a dentist, but merely state that those with higher income had greater odds of visiting a dentist in the past year. Based on our findings, we made qualitative interpretations to help generate working hypotheses that may be tested in future studies.

Higher proportions of annual dental visit and teeth cleaning in KY conflict with greater proportion of tooth loss in the nation. It is known anecdotally that one should see a dentist at least once per year, for example, from toothpaste commercials. Therefore it is conceivable that the reported annual dental visits in KY could have resulted from successful marketing activities that increase awareness rather than actual increased frequency of visits. This idea is supported by the general observation that several dental practices subsidize the first diagnostic and cleaning visit.<sup>8</sup> In a resource- and service-poor setting, this mechanism may explain the apparently conflicting observation of high annual visit and teeth cleaning proportions with high prevalence of tooth loss.

Dental care system utilization proportion measured by dental visits in the past year exhibited an interesting pattern, being greater for the younger Kentuckians, and seeming to decline in a dose-response manner with age. This pattern may be explained in several ways. It might be possible that Kentuckians neglect their oral health as they get older, perhaps as a result of reduced discretionary income and lack of insurance due to loss of job or retirement. However, considering the substantially increased odds of tooth loss among older Kentuckians compared to younger, it seems unlikely that oral health is neglected with age. Rather, it is possible that Kentuckians visit the dentist for symptomatic relief, preferring tooth extraction until complete edentulousness minimizes their self-perceived need to visit a dentist. Firm conclusions can only be reached if timing of age at tooth loss can be ascertained.

There may be another explanation for the above observation worth considering—healthy survivor effect could lead to survival of those Kentuckians into older ages that have healthier mouths. If such an effect exists, it can explain the observations of the data presented in this report. If true, then these Kentuckians may rationalize that they do not need to visit a dentist because of their perceived healthy mouth. By extension, edentulism can also impart a similar belief. This view may be supported with an argument that because US census bureau data<sup>9</sup> suggest that whereas the proportion of people 65 years or older in KY is comparable to the US (12.6% vs 12.4%, respectively), 2002 total mortality rates per 100,000 population of KY (994.3) were substantially higher than that of the US average (847.3) as were all the age-specific mortality rates.<sup>10-12</sup> Although these comparisons are ecological in nature, the situation offers the possibility of generating important hypotheses that may lead to better understanding and development of sound dental public health strategies in KY.

Compared to the US average, significantly more Kentuckians across all education and income groups reported having lost 6 or more teeth, or all their teeth. Considering KY's

poorer macro-economic indicators compared to the US average, very few local health departments and community-based health centers, including community migrant and homeless health centers, have an oral component. Dental visits for adults under the Medicaid program have been limited to one non-emergency visit per month unless waived by medical necessity, and the reimbursement fees are so low that many dentists in private practice cannot afford to treat the Medicaid population. Tooth extraction may have become the treatment of choice for adults enrolled in Medicaid because restorative treatment is not covered under the program and its cost is beyond most Kentuckians' means. It appears that policy makers have failed to implement "support-led" programs and policies that would increase awareness and oral health care access for the socio-economically challenged sections of the population. Edentulism may constitute an additional burden that causes further decrements in the general well-being and quality of life of Kentuckians. As leaders of a poor agrarian state, political responsibility of the policy makers cannot be ignored as a potential major contributor in providing oral health related infra-structural support to Kentuckians.

Probable solutions to these issues may include increasing funding to improve oral health awareness, establishing a series of safety-net institutions throughout the state to increase access for citizens who are indigent or are enrolled in Medicaid or K-CHIP programs, and increasing the reimbursement levels for Medicaid and K-CHIP. In 2004, KY had 2263 licensed dentists but only 937 billed Medicaid for services.<sup>13</sup> Dentist presence in underserved areas may be improved through dental school loan-repayment/forgiveness programs for dentists who practice in underserved areas, which could be full-time/part-time presence or other optimum time-utilization schemes. These arrangements might compensate for barriers that dentists may face in terms of lower income, decreased quality of life, and greater distances traveled to practice in underserved areas.

## CONCLUSION

Although indicators for access and preventive activities seem to rank KY favorably when compared to the nation, KY continues to have one of the highest rates of edentulism in the country and lags behind on most indicators for Healthy People 2010 oral health goals. Improving the oral health status of Kentuckians should be a priority for policy makers. Additional resources must be channeled to increase oral health awareness, create and maintain preventive programs, improve the social insurance programs, increase the availability of providers in rural areas, and encourage practitioners to serve the poor by improving the reimbursement of social entitlement programs.

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# A FORMAL RECEPTION IMPROVES ORTHOPAEDIC SURGERY RESIDENCY PROGRAM APPLICANT PERCEPTIONS OF THE INTERVIEW EXPERIENCE

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Orthopaedic surgery residency program (OSRP) applicant selection is an essential part of program success. The perceived quality that applicants place on an OSRP may influence whether or not they apply. Efforts are being made in Kentucky to recruit the best possible applicants for residency programs. This study evaluated the relationship between the pre-interview reception structure and applicant perceptions of the interview process. A retrospective study of prospectively collected data from all OSRP applicants interviewed between 2001 and 2006 was performed. Applicants interviewed between 2002 and 2006 received an informal reception without direct faculty involvement. Applicants interviewed between 2000 and 2001 received a formal reception with direct faculty involvement. The overall response rate was 86.4% (178 of 206 interviewees). Applicants who participated in the formal reception developed a more positive perception of the interview process (Fisher's Exact Test = 7.71,  $P = 0.035$ ). Presenting a positive image of the OSRP as an important marketing tool. The formal reception generated a more positive applicant perception.

## INTRODUCTION

The orthopaedic surgery residency interview process is expensive in terms of both time and money for the applicant and for the program.<sup>1</sup> The interview process can serve as an important tool for evaluating an applicant's cognitive skills, motor abilities, and noncognitive factors, often helping programs to develop their candidate rank lists.<sup>2,3</sup> While the interview functions as a valuable tool for programs in deciding which applicants they will rank highly, it also serves an important purpose for the applicant in determining which program they perceive to

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best meet their needs and where they believe that they will best "fit in."

Studies of different medical specialties have noted that a wide variety of factors influence applicant perceptions of a residency program.<sup>4-7</sup> Milne et al<sup>4</sup> reported that 65% of internal medicine interns believed that the interview had an impact on their rank list. Top priorities during the interview day were to learn about the program, promote their positive qualities, determine faculty interest in the program, and assess their own level of interest in the program.<sup>4</sup> In a study of otolaryngology residency program applicant rank lists, Stringer et al<sup>5</sup> reported that satisfaction of current residents, perceived faculty quality, and "feeling comfortable" with the program were highly influential factors. The interview itself was considered of medium importance.<sup>5</sup> In reviewing applicants in all medical specialties, Simmonds et al<sup>6</sup> noted that interaction with a program house officer and the applicants' overall impressions at the time of the interview were the most important factors influencing their opinion of the program. DeSantis and Marco<sup>7</sup> noted that an emergency medicine residency program applicant's perception of friendliness, a positive work environment, interview day, a

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strong graduate level academic curriculum, and desired program location were important decision making factors. Desantis and Marco<sup>7</sup> suggested that while residency programs consider applicant records and previous accomplishments of applicants, the applicants themselves largely select programs based on the overall impressions that they develop during the interview day.

Bunch et al<sup>8</sup> reported that the most important source of orthopaedic surgery residency program applicant information is provided by current residents at their school who recently completed the match themselves, and the directory of orthopaedic surgery residency training programs (the green book). Both of these sources were considered to be more important information sources than departmental chairmen or faculty advisors.<sup>8</sup> Information obtained by orthopaedic surgery residency program applicants from current residents at their own school likely comes from sharing of previous interview and match process experiences.

The interview serves as a potentially important recruiting tool for participating orthopaedic surgery residency program applicants and also serves an important public relations marketing and promotional function for the orthopaedic surgery residency program, the school, the university, and the community where it is located. Berkowitz<sup>9</sup> described the four "P's" of marketing as product, price, place, and promotion.

Efforts are being made in Kentucky to recruit the best possible applicants for residency programs. This study was performed to evaluate the influence of having a formal, faculty-directed and structured pre-interview day reception on applicant perceptions of interview process quality versus having an informal, resident-applicant pre-interview social mixer reception without program faculty involvement. Our literature search did not reveal any previous studies that evaluated the influence of faculty involvement in a formal, pre-interview reception on orthopaedic surgery residency training program applicant perceptions of interview process quality.

## MATERIALS AND METHODS

A retrospective, IRB-exempt study of prospectively collected data from all orthopaedic surgery residency program applicants interviewing between 2001 and 2006 at a university-based program with a level-one trauma center was performed. Applicants responded to a single Likert-style question that asked: "How did this interview day experience compare to those that you participated in at other orthopaedic surgery residency programs?" Response options were 4 = much better, 3 = a little better, 2 = the same, and 1 = worse. Applicants were asked to voluntarily and anonymously answer the question after completing their interviews and tours of the health sciences campus and local community.

In 2001 and 2002 the pre-interview reception at our program was a formal, faculty-directed program held in a conference room at an area hotel. This program included oral presentations by the departmental chairman, vice-chairman, and chief of the trauma service, the residency program director, and the administrative chief resident (Fig. 1). Speakers each provided a 30 to 40 minute presentation describing the program's history, vision and mission, service rotations, performance expectations, and values. Largely based on resident perceptions, between 2003 and 2006 the pre-interview reception was changed to a more informal structure, with a brief presentation by the administrative chief resident, followed by dinner and drinks at a local restaurant/bar. No faculty was present for this new pre-interview reception format. Similar information was provided to applicants the morning of the interviews; however, it was condensed into a 60-minute session with presentations just from the departmental chairman and residency program director. The interview style that was used to evaluate applicants remained constant throughout the study period with 2 to 3 faculty members per session and 5 to 6, 10 to 15 minute duration sessions.

Responses to the perceived interview quality question were analyzed using a Fisher's Exact Test (SPSS version 11.0 for MS Windows, SPSS, Chicago, IL) to determine if response fre-

quencies differed between groups. An alpha level of  $P < 0.05$  was selected to indicate statistical significance.

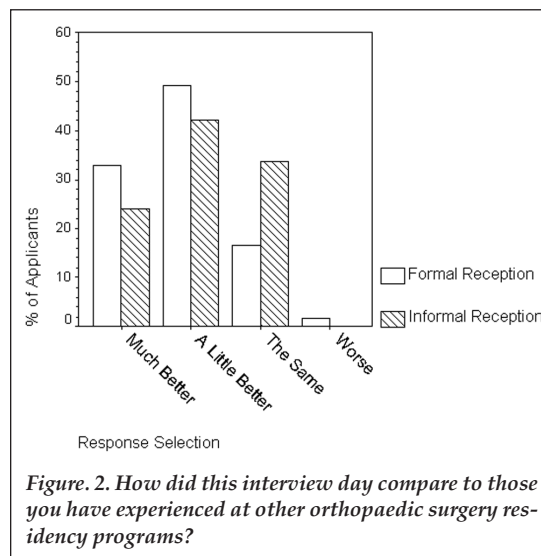
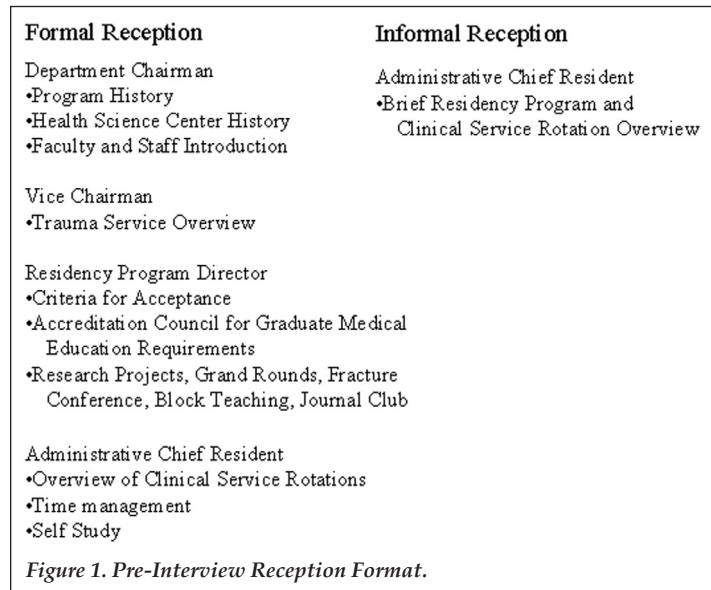
**RESULTS**

The majority of applicants who were invited to interview responded to the question (86.4%, 178 of 206) with comparable response rates for each group. The average number of previous orthopaedic surgery residency program interviews that applicants had participated in was 7 with a range of 4 to 12. A significantly greater percentage of applicants who participated in the formal pre-interview reception rated the interview as being superior to other programs compared to applicants who participated in the informal pre-interview reception (Fisher's Exact Test = 7.71,  $P = 0.035$ ) (Fig. 2).

**DISCUSSION**

Applicants who participated in the formal pre-interview reception with faculty involvement had a more positive perception of the interview process compared to other programs that they had visited than applicants who participated in the informal pre-interview reception. The formal reception may have been preferred because applicants had a perception of increased faculty interest and involvement.

Implementation of the Electronic Residency Application Service has enabled applicants to apply to a large number of orthopaedic surgery residency programs in an attempt to increase their chances of acceptance given the competitive applicant pool. Over the 6-year study period, orthopaedic surgery residency program applicants at our program who were invited to interview have come from across the US and from several foreign countries (Fig. 3). With applicants sending out increasing numbers of interview requests, expenses related to time, travel, and housing also increase. Since the interview process is a considerable expense to the applicant, some may reduce the total number of programs that they visit. Conceivably, applicants with higher USMLE Part I scores may be-



come more selective regarding program visits, interviewing at only a few programs that they consider to be highly desirable.

Given these changes, it is essential that orthopaedic surgery residency programs create a positive perception to their applicants that substantiates the level of faculty interest and involvement in addition to providing comprehensive information. As with healthcare, graduate academic programs are beginning to

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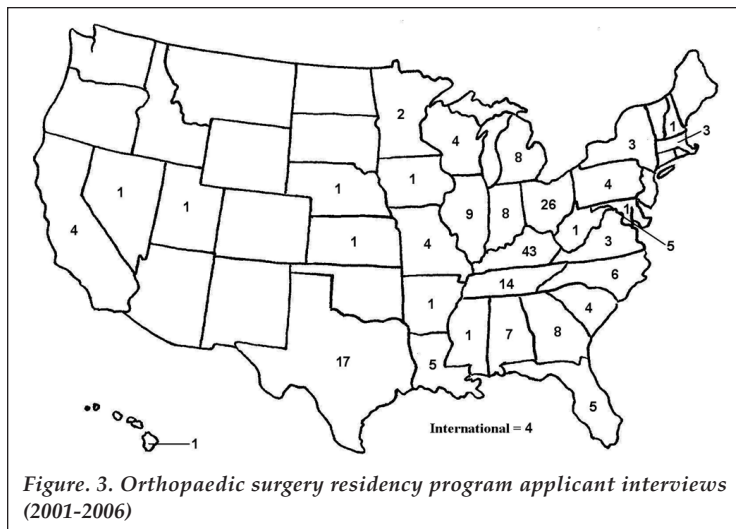


Figure 3. Orthopaedic surgery residency program applicant interviews (2001-2006)

develop a greater appreciation for the influence of marketing and promotional strategies on creating and maintaining a positive consumer impression.<sup>9</sup> By effective marketing and promotion, an orthopaedic surgery residency program is more likely to be perceived as a desired destination for all applicants, including those who possess desirable attributes over and above having a competitive USMLE Part I score. Ultimately this enables the program to be more selective in ranking the applicants who they perceive would ideally “fit in” well and succeed in a given program.

Sledge et al<sup>10</sup> reported that the impression made by faculty created a strong influence on psychiatry residency program applicant rank lists. Other factors that influenced the decision-making process included the program location, perceived quality of the clinical training, and the intuitive feeling that the applicant developed about the program during the interview process.<sup>10</sup> In studying oral and maxillofacial surgery resident satisfaction, Laskin et al<sup>11</sup> reported that a strong predictor was the accuracy of the residency program in representing itself. Perhaps the formal reception provided a better opportunity for our orthopaedic surgery residency program to represent itself with both faculty members and current residents contributing to the overall experience. The commitments of faculty to clinical education<sup>8</sup>, fac-

ulty-resident relations<sup>12</sup>, and quality of faculty<sup>5</sup> have all been cited as top reasons a residency applicant selects a particular orthopaedic, general surgery, and otolaryngology residency program, respectively. Although the formal reception may have decreased the interaction of applicants with residents during the event, this interaction likely occurred at other times during the interview day.

Bunch et al<sup>8</sup> noted that the perception of a disorganized interview day by the applicant was one of five major reasons for them not ranking an orthopaedic surgery residency program. They further noted that the interview process used by some orthopaedic surgery residency programs seemed to be run more for the convenience of the program rather than because it provided a good method of applicant evaluation.<sup>8</sup> Given the competitive nature of the applicant field, many programs may not be aware of the true efficacy of their current program applicant interviewing and ranking program methods. Potentially many strong applicant candidates are not requesting interviews at these programs.

Senior medical students who form the majority of the residency applicant pool undertake significant personal expenses during the interview process. In 2005, American orthopaedic surgery residency program applicants who matched went on an average of 10.9 interviews and more than 20% went on 15 or more interviews.<sup>1</sup> Since interviews are associated with a considerable investment of time and money on the part of the applicant as well as the program, we believe that an orthopaedic surgery residency program that is interested in optimizing the interview day experience based on applicant desires will have a better chance of attracting top applicants. We agree with Evarts et al<sup>2</sup> who stated that resident recruitment and retention was the linchpin to the future of orthopaedic surgery. While recognizing that conducting interviews is demanding and time-consuming for orthopaedic surgery residency program faculty, it is worthwhile if it is preferred by applicants and if it results in a stronger rank list of more qualified applicants. By developing an internal medicine residency program recruitment com-

mittee that critically evaluated the interview process, Flannery and Perez<sup>13</sup> reported a 50% increase in program applications and a 30% increase (21% to 51%) in the number of applicants who ranked the program as one of their top three choices over a 3-year period after interview process changes were implemented.

Study limitations include response bias from the interviewees.<sup>14</sup> Although responses were voluntary and anonymous, applicants may have felt pressured to make a favorable impression during their visit and interview. Therefore, some may have answered the question according to what they perceived that the program deemed to be the "correct" answer. Also, the study group was only comprised of applicants to one university-based program, which may not truly represent the attitudes of applicants in other regions of the United States or those at other orthopaedic surgery residency programs. Additionally, since our program only interviewed on average 34 applicants per year (range = 24-44) over the study period, our sample size was relatively small. Lastly, the study would have been stronger if a prospective design had been developed with randomized applicant assignment to one of two pre-interview reception format groups rather than performing a retrospective review of data that was prospectively collected.

A study strength was that the survey question and the interview format were consistent over the study period. Additionally, the regions of the country from which our applicants came provided a study sample that is representative of most of the US (Fig. 3). Finally, we believe since some applicants indicated that they perceived the interview process to be no better or worse than that experienced at other programs, that they were comfortable that their question response would be kept anonymous, thereby more likely providing an honest answer.

## CONCLUSION

Compared to orthopaedic residency program applicants who participated in an informal pre-interview reception, applicants who partici-

pated in a formal, structured pre-interview reception with faculty involvement perceived the interview process to be superior compared to those experienced at other programs. The interview process is important for both applicants and orthopaedic surgery residency programs. Orthopaedic surgery residency program self-evaluation is important to assure that applicant obtain a positive perceptions of a program based on the interview day. Recruiting the best, most qualified applicants for residency programs is essential to long-term program success.

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