Place Matters:

Understanding Rural/Urban Differences in Motor Vehicles Fatalities in California's San Joaquin Valley

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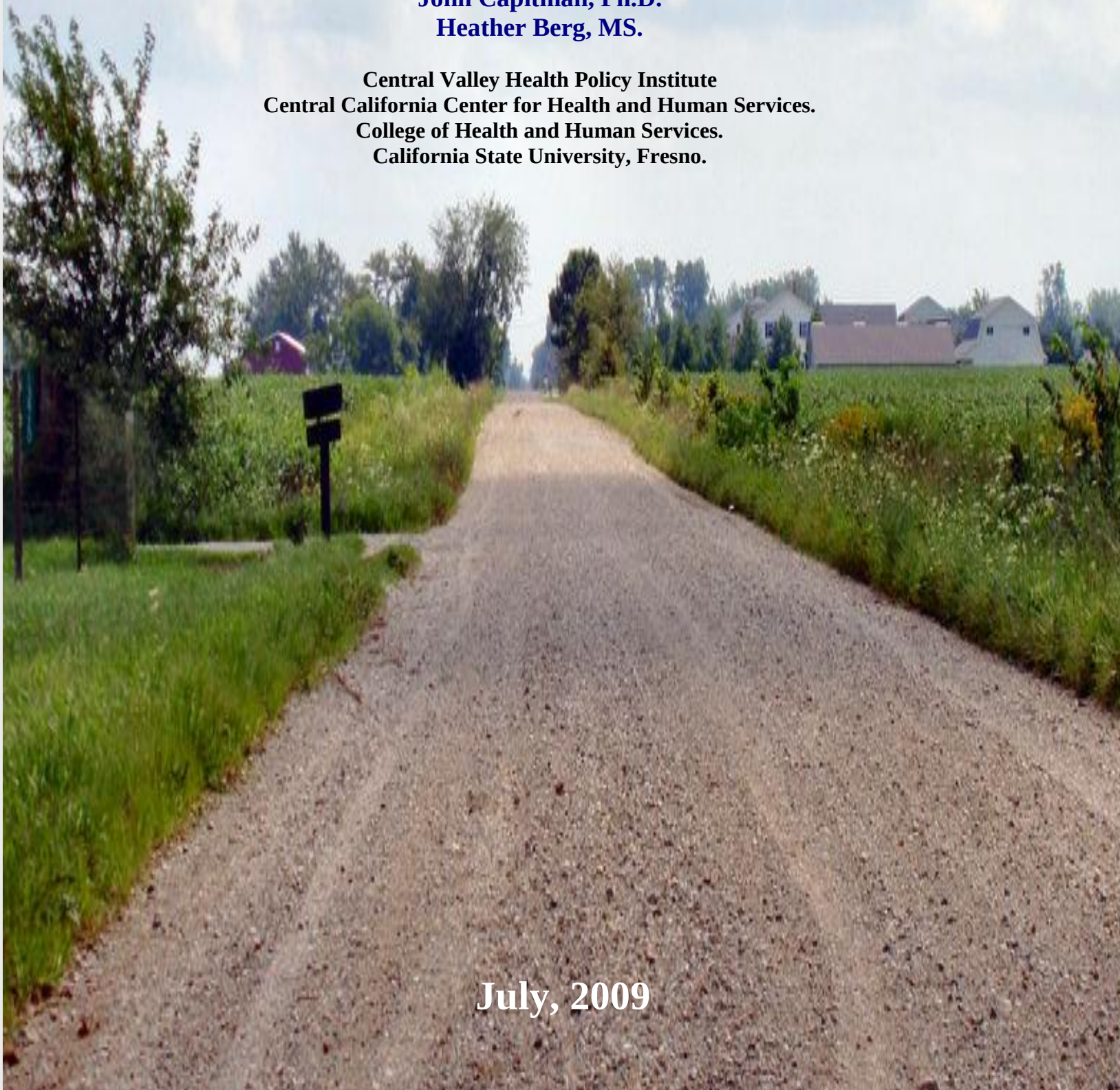

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Executive Summary

Context and Purpose:

The San Joaquin valley (SJV) Place Matters initiative is a collaborative effort between the Central Valley Health Policy Institute (CVHPI) and six of the Valley's eight county health departments (Fresno, Kern, Kings, Madera, Merced, and Tulare). Place Matters is a signature project of the Joint Center for Political and Economic Studies Health Policy Institute (JC HPI). The Joint Center for Political and Economic Studies is one of the nation's premier research and public policy institutions and the only one whose work focuses exclusively on issues of particular concern to people of color.

The mission of the JC HPI is to engage and support communities in designing strategies to reduce/eliminate health disparities using a Social Determinants of Health framework. The Institute's mission is to **ignite a "Fair Health" movement** that gives people of color equal opportunity for healthy lives.

The purpose of this study was to examine the social, behavioral, and environmental determinants of fatal rural motor vehicle accidents in the San Joaquin Valley (SJV). Accidents are the leading cause of death for persons under age 39 in the region and motor vehicle accidents (MVAs) account for the highest proportion of accidental deaths (Bengiamin, et al., 2008). Living in a rural location may contribute to one's risk of being in an MVA. According to the NCSA (2005), rural accidents account for 58% of motor vehicle fatalities, although only 21% of Americans live in rural areas. Further, rural accidents tend to be more severe- victims of rural crashes are also twice as likely to die when compared to urban crashes (Chen, et al., 1995).

While driver related factors have been the focus of most analyses, environmental factors such as road condition remain largely unexplored. The NCSA (2005), however, proposes that environmental factors play a large role in the increased amount of MVAs in rural areas. It is possible that such factors explain a substantial share of the differences between rural and urban MVAs, as well as higher fatality rates for specific populations.

The prevalence of MVAs in California's San Joaquin Valley is especially high; six of the counties included in the region (Fresno, Kings, Kern, Madera, Merced, and Tulare counties) account for more than 14% of the state's MVAs, but make up only 6.76% of the population (NCSA 2006b; U. S. Census Bureau, 2000).

Two research questions are explored in the current investigation: 1) how do rural and urban MVAs in the Valley differ in terms of the demographics, behavioral, and environmental factors associated with them, and 2) does Latino/non-Latino ethnicity differentiate rural and urban accidents when other factors are considered. Based on the differences in funding and road quality described above, we expect to find a significant difference between rural and urban MVAs in terms of the environmental factors associated with each. Given that environmental conditions are anticipated to play a more crucial role than has been previously considered, it is expected that driver characteristics such as race/ethnicity will be less important in the discrimination of rural versus urban MVAs.

Methods:

An analysis of FARS data for six San Joaquin Valley counties (Fresno, Kern, Kings, Madera, Merced, and Tulare) from 2001 to 2005 was conducted. The final database consisted of 5,991 individuals, 3,134 drivers, and 2,034 fatal MVAs.

We used chi-square tests to evaluate the association between rural and urban accident sites. Separate chi square analyses were conducted for driver and environment characteristics in order to prevent analysis of duplicate events. Then we conducted discriminant function analyses using FARS data to examine which factors discriminate between fatal urban and rural MVAs. Discriminant function analysis is a multivariate technique that identifies the combination of variables that best differentiates the members of two or more groups. We used stepwise analyses to determine how important each set of variables are to the classification of rural versus urban MVAs. FARS variables were divided into three categories of independent variables- driver characteristics, driver behaviors, and environmental characteristics- and multiple category variables were recoded into sets of dichotomies where necessary. Accidents were coded as rural or urban by the source agencies according to U.S. Census Bureau definitions.

In the first analysis, only driver characteristic variables were examined. Driver characteristic and driver behavior variables were then combined for the second analysis. Environmental variables were then added so that all three sets of variables were included in the third analysis. F values for the stepwise analyses were set at .025 to enter and .05 to remove in order to reduce the impact of multiple tests with a large sample.

The same procedures were used to conduct analysis for each county separately.

Results:

Analysis of FARS data indicated that 1,325 (65%) of the 2,034 fatal accidents in the six counties from 2001 to 2005 occurred on rural roads. For all SJV counties, rural accidents were more frequent than urban.

Results from chi square analysis showed significant associations between accident location and several driver and environmental variables in the SJV. Drivers involved in rural

accidents differed from those involved in urban accidents on both social/demographic characteristics such as gender, air bag availability, and vehicle age as well as driving behaviors such as restraint system use, travel speed, and DWI. Many of the environmental conditions also differed between rural and urban MVAs, including for example speed limit, traffic signal/sign, and lighting. While results varied slightly across counties in terms of specific variables, a pattern of significant characteristics, behaviors, and (in particular) environmental conditions was revealed.

The variables showing most importance in discriminating between rural and urban MVAs were related to environmental conditions. Latino ethnicity was not found to be an independent discriminating factor in rural/urban MVA disparity.

Conclusion:

While intervention efforts have traditionally focused on influencing driver behaviors, the results of this study indicate that interventions and preventative measures must address the environmental conditions associated with rural MVAs. Further study (especially community-based participatory research) is needed to examine the relative roles of drivers and environmental and structural conditions in rural MVAs.

Planned next steps include two phases- a pilot project phase and a subsequent replication phase involving communities throughout the region. The goal of the planned pilot project is to facilitate understanding of and identify and implement solutions to MVA inequities and their underlying causes in four communities in two Valley counties. Teams of residents, community-based organizations, and decision- makers will be created and supported in identifying the social determinants and immediate causes of MVAs in their communities and developing and implementing plans to address these challenges. In addition, qualitative research in the form of

focus groups and interviews will be conducted that provide community members with the opportunity to be involved in the investigation and discussion of causes and solutions.

Residents of rural communities in the SJV, and especially those that are unincorporated, are pervasively politically under-represented, have low-incomes, and are under-educated. Because of this, and because rural communities also experience higher rates of MVA fatalities in the Valley, the overall goal of the project is to reduce the amount of MVAs in rural communities by engaging citizens in direct participation and discussions about causes and solutions and creating partnerships between community groups and local agencies.

The second phase of the planned project focuses on the replication of the best features of the pilot project in each of the Valley's eight counties. Expansion and development of the pilot project is planned, and leaders from the pilot project communities will be recruited to mentor emerging community development groups in nearby communities, creating opportunities for shared learning for CBO staff and residents in each participating community.

Place Matters: Understanding Rural/Urban Differences in Motor Vehicles Fatalities in California's San Joaquin Valley

1. Context

The San Joaquin valley (SJV) Place Matters initiative is a collaborative effort between the Central Valley Health Policy Institute (CVHPI) and six of the Valley's eight county health departments (Fresno, Kern, Kings, Madera, Merced, and Tulare). Place Matters is a signature project of the Joint Center for Political and Economic Studies Health Policy Institute (JC HPI). The Joint Center for Political and Economic Studies is one of the nation's premier research and public policy institutions and the only one whose work focuses exclusively on issues of particular concern to African Americans and other people of color. For over three decades, the Joint Center research and information programs have informed and influenced public opinion and national policy to benefit not only African Americans, but every American.

In 2002, the W. K. Kellogg Foundation awarded the Joint Center a $7million grant to establish a *Health Policy Institute* that would contribute to improving the health of underserved and diverse Americans by informing policy and sharing promising practices. The mission of the JC HPI is to engage and support communities in designing strategies to reduce/eliminate health disparities using a social determinants of health framework. The Institute's mission is to **ignite a "Fair Health" movement** that gives people of color equal opportunity for healthy lives. The goal is to help communities of color identify short- and long-term policy objectives and related activities in the following seven key areas:

- Identifying and addressing the economic, social, environmental and behavioral determinants that can lead to improved health outcomes

- Increasing resource allocations for prevention and effective treatment of chronic illness
- Informing the policy and practice of reducing infant mortality and improving child and maternal health
- Reducing risk factors and supporting healthy behaviors among children and youth
- Improving mental health and reducing factors that promote violence
- Optimizing healthcare access and quality
- Creating conditions for healthy aging and improving the quality of life for seniors

JC HPI conducted research to identify the counties that would be best served through this initiative by using Census 2000 data and the Behavioral Risk Factor Surveillance System (BRFSS). A total of 149 counties nationwide were identified. From this group, 16 teams, 24 jurisdictions (across 22 counties and two cities) were selected as the pilot communities for the national learning community. When Fresno County was contacted to join the JC HPI, Dr. John Capitman (Executive Director of CVHPI) requested that we join as a region in light of the fact that Valley counties face similar economic, political, social, and health challenges. In recent years, the SJV has become known as the "Appalachia of the West." In fact, a report released in December by the Congressional Research Service found that per-capita income in the SJV is lower than in Central Appalachia--while federal spending per capita is less. Fewer of the Valley's residents have an education beyond a high school diploma; this is true in each of the eight counties (San Joaquin, Stanislaus, Merced, Madera, Fresno, Kings, Tulare and Kern) that make up the region. Further, the Valley's deteriorating air quality is the second worst in the nation. These problems are compounded by the Valley's rapid growth; the population is projected to double by 2040. Historically, the SJV region has not had the resources to address the challenges it faces.

Since June of 2006, the SJV Place Matters Design Team has attended eight Design Labs that have been convened to facilitate Place Matters teams' goals in addressing social determinants of health in their communities through upstream approaches.

Social Determinants of Health

Social determinants of health refer to conditions of society that reflect root causes of community and individual health and well-being. Examples include quality and affordability of housing, availability of mass transportation, quality of education, chronic stress, racism, social exclusion, and poverty.

"Upstream-ness"

Upstream-ness refers to the ability of an activity to address those things in the social structure that deny certain people voice, power, and political influence in society (e.g., class exploitation, racism, and gender discrimination). For example, rather than seeking to eliminate obesity through fitness education alone, an intervention focused on the upstream causes of obesity might address the reasons behind a lack of investment in green spaces and grocery stores in communities with a high proportion of minority residents.

The long-term goal of the SJV Place Matters initiative is to reduce the prevalence of motor vehicle fatalities on the region's rural roads to reflect the goals of Healthy People 2010 (to a rate of 9.2 per 100,000 people). The extensive involvement of underrepresented community members (especially minority, low-income, and rural residents) in addressing, resolving, and planning to improve safety and access issues on rural roads and regional economic, environmental, and health inequities in general is also a principal mission of the project. The purpose of the study presented here was to examine the social, behavioral, and environmental

determinants of rural versus urban motor vehicle fatalities in the Valley, with the intention to inform future intervention.

2. Introduction

Accidents are the leading cause of death for persons under age 39 in the region and motor vehicle accidents (MVAs) account for the highest proportion of accidental deaths (Bengiamin, et al., 2008). MVAs are the leading cause of death for individuals between the ages of 2 and 34 in the United States (National Center for Statistics and Analysis [NCSA], 2007a). According to the NCSA (2007a), 42,642 people were killed and 2, 57,000 people were injured in the nearly 6 million police-reported accidents in the year 2006; the national economic loss of MVAs in 2000 was estimated to be upwards of $230 billion dollars. An analysis of the 2002 Death Statistical Master File found that San Joaquin Valley Latinos and American Indians had higher mortality rates for MVAs than Valley residents of all other ethnicities (State of California Department of Health Services, 2002).

Living in a rural location may contribute to one's risk of being in an MVA. According to the NCSA (2005), rural accidents account for 58% of motor vehicle fatalities, although only 21% of Americans live in rural areas; and rural accidents tend to be more severe, disabling 14% more vehicles in fatal collisions than in urban areas (81% to 67%). In addition, victims of rural crashes are also twice as likely to die when compared to urban crashes (Chen, et al., 1995); a study by Muelleman & Mueller (1996) found that fatality rates in MVAs are inversely proportional to population densities. Residents of rural communities are likely to be at the greatest risk for dying in MVAs, as they are presumably most likely to travel on rural roads.

The NCSA (2005) proposes that environmental factors such as lack of lighting and higher speed limits play a large role in the increased amount of MVAs in rural areas. The center reports that, of the 46% of crashes that occur at night in rural areas nationally, 90% of them occur on darkened roadways. Roughly ¼ of all motor vehicle fatalities occurred on dark, rural roads. Further, "over 70 percent of the fatal crashes on roadways with speed limits of 55 mph or higher occur in rural areas" (p. 2).

Both race/ethnicity and socioeconomic status have also been found to be associated with fatal MVAs in recent studies conducted across the country (Harper, et al., 2000; NCSA, 2006a; Whitlock, et al., 2003). In a study in Colorado, for example, Latino drivers were found to have a significantly higher MVA fatality rate than non-Latino whites (Harper, et al., 2000). The authors found lower rates of seat-belt use and greater rates of intoxication, speeding, and driving without a valid license in the Latino population. Higher rates of MVA fatalities amongst the Latino community were also found when compared to non-Latino whites in a North Carolina study by March et al. (2003). Braver (2003) found that intoxication rates and seat-belt non-compliance were more an issue of socioeconomic status than of race, however. This was corroborated by a later study in which high levels of education and income were found to protect against incidence of driving while intoxicated (Romano, et al., 2005).

The relationship between driver behaviors such as seat-belt use, speeding, and driving while intoxicated (DWI) and higher MVA rates have been well documented (Harper, et al., 2000; NCSA, 2006a; Romano, et al., 2005). The role of driver characteristics such as socio-economic status, race/ethnicity, and rural residence has also been studied, both individually and in terms of their interaction with behaviors (Braver, 2003; Campos-Outcalt, et al., 2003). While

driver related factors have been the focus of most analyses, environmental factors such as road condition remain largely unexplored. It is possible that such factors explain a substantial share of the differences between rural and urban MVAs, as well as higher fatality rates for specific populations. Further, as far as we can tell, prior research has not addressed the issue of motor vehicle accidents from a multivariate perspective. Such research would adjust for a wider range of contributing factors and give a clearer understanding of where intervention efforts should be focused.

In 2006, the National Safety Council (NSC) estimated that every motor vehicle fatality cost an average of $1,210,000. The criterion for this estimation was "wage and productivity losses, medical expenses, administrative expenses, motor vehicle damage, and employers' uninsured costs (NSC, 2006)." Government, the healthcare industry, providers, and patients absorb the financial burden of MVAs (Gardner, et al., 2007; Hearrell & Burke, 2007). The national MVA cost in 2000 was estimated to be $230 billion (Gardner et al., 2007); the cost to rural communities of low socioeconomic status is highest because of the high number of MVAs occurring in these regions and the small amount of resources available to them. As these communities lack the capacity to meet the high costs of MVAs, the investigation of those factors associated with rural accidents and efforts to intervene are particularly important.

Social Economic Status, Ethnicity, and Rural Road Conditions May Contribute to the High Rate of San Joaquin Valley MVAs

The prevalence of MVAs in California's San Joaquin Valley is especially high; six of the counties included in the region (Fresno, Kings, Kern, Madera, Merced, and Tulare counties) account for more than 14% of the state's MVAs, but make up only 6.76% of the population

(NCSA 2006b; U. S. Census Bureau, 2000). There were 14.66 per 100,000 people who died nationally in MVAs in 2005 and 11.98 in the state of California (http://www.cacrash.org/index.html). MVA mortality rates in 2005 in the San Joaquin Valley were much higher than both of California and the U.S. - the average MVA rate for the six counties mentioned above was 26.2 per 100,000. Kings County's fatality rate was 32.08 per 100,000 people in that year- almost three times higher than the state and twice the national rate.

The San Joaquin Valley, and most notably its rural communities, is characterized by high proportions of Latino residents with low incomes. Each of the Valley's counties has greater numbers of Latinos than the state as a whole; more than half of the incorporated cities and towns in the region have populations that are more than 50% Latino and more than a quarter are more than 75% Latino (U.S. Census Bureau, 2000). Many Latino residents in the Valley are economically disadvantaged, especially in rural areas. The most disadvantaged rural residents in the region may be the residents of the Valley's 50 *colonias* (rural communities with populations under 20,000 whose residents are at least 50% Latino and 15% agricultural workers, and with poverty rates of at least 20%). The average percentage of Latino residents in these communities in 2000 was 79. Further, the average unemployment rate in the Valley's colonias was 23%, the average percentage of families in poverty with a child under five years old was 43, and the average percentage of residents who were employed by the agriculture industry was 35.

In light of these statistics, findings suggesting that rural residency, lower socioeconomic status, and Latino ethnicity are strongly associated with MVA fatalities are especially important to motor vehicle safety in the region (Braver, 2003; Campos-Outcalt, et al., 2003; NCSA, 2005). Because rurality, race/ethnicity, and poverty are so intertwined in this region, multivariate research is needed to provide a better understanding of the differences between rural and urban

MVAs and to inform interventions. Further, because prior studies on the influence of race/ethnicity have not used a multivariate approach, this study explores the extent of the influence of race/ethnicity on rural-urban differences in MVAs.

In past years, research has demonstrated the heightened dangers of driving in rural areas. There is much discussion in peer-reviewed literature regarding the causes of MVAs. Previous discussions have focused on individual behavior; the current investigation adds to the discussion by examining social, behavioral, and environmental causes. Two research questions are explored: 1) how do rural and urban MVAs in the Valley differ in terms of the demographics, behavioral, and environmental factors associated with them, and 2) does Latino/non-Latino ethnicity differentiate rural and urban accidents when other factors are considered. Based on the differences in funding and road quality described above, we expect to find a significant difference between rural and urban MVAs in terms of the environmental factors associated with each. Given that environmental conditions are anticipated to play a more crucial role than has been previously considered, it is expected that driver characteristics such as race/ethnicity will be less important in the discrimination of rural versus urban MVAs.

3. Method

Data

This is a cross sectional study using the U.S. Department of Transportation's Fatality Analysis Reporting System (FARS). The FARS database includes MVAs that result in a death within 30 days of the event. Each case in the database includes information on the individuals (including drivers, passengers, and non-motorists) and vehicles involved in the accident. Also included are road and meteorological conditions and occurrence of other events at the time of the accident.

Because FARS data on race and ethnicity are only available for fatalities and was missing at the time of the analyses for Valley counties for 2005, a third database was created to investigate the role of ethnicity in regional rural and urban MVAs. All cases for which ethnicity data were available were selected from the first sample of drivers, resulting in ethnicity data for 1,060 fatally injured drivers. Discriminant analyses for driver characteristic, driver behavior, and environmental condition variables were then conducted using the significant variables from the first analysis, once with the race/ethnicity variable (Latino or non-Latino) included and once without.

Variables

FARS variables were divided into three categories- driver characteristics, driver behaviors, and environmental characteristics- and multiple category variables were recoded into sets of dichotomies where necessary. Accidents were coded as rural or urban by the source agencies according to U.S. Census Bureau definitions.

Procedure and Analysis

An analysis of FARS data for six San Joaquin Valley counties (Fresno, Kern, Kings, Madera, Merced, and Tulare) from 2001 to 2005 was conducted. Fatal MVAs occurring on major interstates and special jurisdictions (national parks and military bases, for example) were excluded so that the final sample would more accurately represent local drivers and roads. The final database consisted of 5,991 individuals, 3,134 drivers, and 2,034 fatal MVAs.

Because FARS data included information on drivers in multiple-vehicle accidents, the potential existed to attribute too much variance to context features. In order to overcome this potential bias, we developed analytic files with only one driver for each accident event. The first data file consisted of all drivers in single-car accidents, as well as the first driver from all

multiple-car accidents. A second database was then created that included all drivers from single-car accidents, plus the second driver from all multiple-car accidents. To assess whether or not bias had been introduced into the analysis, we conducted all analyses using the both database. Results for all analyses were comparable. For the purpose of this report data from the first database is used.

We used chi-square tests to evaluate the association between rural and urban accident sites. Separate chi square analyses were conducted for driver and environment characteristics in order to prevent analysis of duplicate events. Then we conducted discriminant function analyses using FARS data to examine which factors discriminate between fatal urban and rural MVAs. Discriminant function analysis is a multivariate technique that identifies the combination of variables that best differentiates the members of two or more groups. We used stepwise analyses to determine how important each set of variables are to the classification of rural versus urban MVAs. Discriminating items were categorized into three sets of variables: driver characteristics, driver behaviors, and environmental conditions. In the first analysis, only driver characteristic variables were examined. Driver characteristic and driver behavior variables were then combined for the second analysis. Environmental variables were then added so that all three sets of variables were included in the third analysis. F values for the stepwise analyses were set at .025 to enter and .05 to remove in order to reduce the impact of multiple tests with a large sample.

The same procedures were used to conduct analysis for each county separately.

4. Results

Rural MVAs Differed from Urban MVAs in the SJV for Driver Characteristics, Driver Behaviors, and Environmental Characteristics

Analysis of FARS data indicated that 1,325 (65%) of the 2,034 fatal accidents in the six counties from 2001 to 2005 occurred on rural roads. Those involved in fatal accidents in the

Valley (including drivers, passengers, and non-motorists) from 2001 to 2005 were most frequently local residents (88% of all individuals in the final database). For all SJV counties, rural accidents were more frequent than urban (see Table 1). This was especially true for the smallest counties (Kings and Madera).

Table 1. Rural and urban fatal MVAs in SJV counties, 2001-2005, N = 2388

	Fresno County	**Kern County**	**Kings County**	**Madera County**	**Merced County**	**Tulare County**
Rural Fatal MVAs	341 (55%)	311 (57%)	115 (82%)	126 (85%)	157 (77%)	273 (74%)
Urban Fatal MVAs	283 (45%)	239 (43%)	25 (18%)	22 (15%)	47 (23%)	95 (26%)
Total Fatal MVAs	**624**	**550**	**140**	**148**	**204**	**368**

Results from chi square analysis showed significant associations between accident location and several driver and environmental variables in the San Joaquin Valley (see Tables 2 and 3). Drivers involved in rural accidents differed from those involved in urban accidents on both social/demographic characteristics such as gender, air bag availability, and vehicle age as well as driving behaviors such as restraint system use, travel speed, and DWI. Many of the environmental conditions also differed between rural and urban MVAs, including for example speed limit, traffic signal/sign, and lighting.

Table 2. Urban/rural differences in driver characteristics and behavior: MVAs in the San Joaquin Valley 2001-2005, N = 3134

Driver Characteristic or Behavior	**% Urban**	**% Rural**	**p ≤**
Urban			
Air Bag Available/Functional	**56.3**	49.5	.001
Driver with 1 or More Suspension(s)/ Revocation(s) within 3 years Prior to Accident	**20.7**	14.3	.001
Inoperable Vehicle Equipment (i.e., Headlights)	**8.9**	5.6	.001
Driver Inattentive (i.e., Eating, Fatigue, Cell Phone Use)	**13**	9.7	.01
Driver with 1 or More DWI Conviction(s) within 3 years Prior to Accident	**9.3**	6.7	.01
Rural			
Driver Reported as DWI	6.6	**9.9**	.001
Driver Received Violation for Mistake (i.e., Improper Passing)	2.5	**4.7**	.001
Restraint System Use	67.8	**69.9**	.001
Travel Speed Greater than 55mph	9.9	**16.7**	.001
Vehicle More Than 10 Years Old	26.7	**32.2**	.001
Male	72.6	**76.9**	.01
Weekend (Friday through Sunday)	47.4	**53.5**	.01

Table 3. Urban/rural differences in environmental characteristics: MVAs in the San Joaquin Valley 2001-2005, N = 2034

Environment/Road Characteristics	**% Urban**	**% Rural**	**p ≤**
Urban			
Collision with Pedestrian or Pedal Cyclist	**39.1**	10.8	.001
Dark Roadway with Lighting	**29.2**	4.5	.001
Daylight	44.8	**52.3**	.001
Exit/Entrance Ramp	**1.3**	0	.001
Intersection or other Junction	**37.3**	22.5	.001
One-Way Road	**1.4**	.1	.001
Traffic Sign or Signal	**31.9**	22.5	.001
Two-Way Road with Physical Barrier	**7.3**	1.2	.001
Non-Adverse Weather	**96.1**	93.3	.01
Rural			
Collision with 1 or More Other Vehicles	35.2	**45.9**	.001
Dark Roadway with No Lighting	22.1	**38.8**	.001
Non-Collision, Including Rollovers	13.5	**31.2**	.001
Speed Limit Over 45mph	55.4	**66.5**	.001
Two-Way Road with No Physical Barrier	87.8	**98.1**	.001
Vision Obscured (i.e., by Weather, Obstruction, Glare)	.9	**1.8**	.05

In each of the Valley's counties, rural MVAs were found to differ from urban for both driver and environmental variables. The driver characteristic variables that were most common in rural accidents throughout the region were having a vehicle that was more than ten years old, and not having a valid license. Urban accidents more often involved drivers with previous accidents, suspensions, and convictions (for speeding or DWI, for example). The driver behaviors that were more common to rural accidents included higher traveling speeds (but not speeding) and driving on the weekend. Environmental conditions common to rural accidents in the region as a whole included a scarcity of lighting and physical barriers, as well as higher speed limits.

5. Discussion

As expected, significant differences between rural and urban MVAs were found in this investigation. Fatal rural MVAs in California's San Joaquin Valley were more frequent than urban MVAs in the area. In addition, environmental factors were most important in discriminating between rural and urban MVAs, while driver characteristics (such as age and gender) and driver behaviors (such as speeding and DWI) played smaller roles. Race/ethnicity was not found to be an independent factor discriminating between rural and urban accidents in the region.

The importance of environment in differentiating between rural versus urban MVAs supports national analyses pointing to substandard road conditions (NCSA, 2006b) as a key factor in rural accidents. According to a report by the Federal Highway Administration and the National Highway Traffic Safety Administration (as cited in Fresno County Department of Public Works & Planning, 2004), substandard road conditions contributed to 45% of MVAs in 2000. A report on the Fresno County road system from the Fresno County Department of Public

Works & Planning (2004), cites the underdevelopment of rural roads as an important factor in rural traffic safety, asserting that 70% of its fatal accidents occur on "primarily two-lane undivided roads (p. 10)" and that 75% of travel on its road system occurs in rural areas. According to the report, 3,000 miles of the county's 3,600 mile road system are currently not built to existing safety specifications.

Because population criteria is given more weight in funding calculations than is number of road miles, those counties with the greatest amount of rural roads and highest MVA mortality rates receive smaller amounts of funding for creating safe traffic environments (http://www.cacrash.org/index.html; California Department of Transportation, 2006). For example, the formula used to distribute funding to counties from California's SB 1266 in 2006 based 75% of the funding allocation on the number of vehicles registered in each county relative to those registered in all counties in the state and 25% on the number of county road miles. Because the number of registered vehicles in a county is directly related to its population, rural counties with fewer registered vehicles (and therefore lower populations and more miles of rural roads) receive a smaller share of the funding than more heavily populated counties with fewer miles of rural roads and lower fatality rates.

It is estimated that MVAs cost California over $20 billion in the year 2000 (NCSA, 2006b); MVA costs are high for individual counties, as well. Accidents on Fresno County roads in 2003, for example, were estimated to cost the county $326 million (Fresno County Department of Public Works & Planning, 2004). This amount represents an equivalent of 21% of Fresno County's 2007-2008 fiscal budget (Fresno County Auditor-Controller/Treasurer-Tax Collector's Office, 2007). In the long-term, it would cost Fresno County five times less to

provide adequate maintenance now, than it would to re-construct a badly damaged road in the future (Fresno County Department of Public Works & Planning, 2004).

Current Interventions Focus Exclusively on Driver Behaviors and Fail to Address Environmental Conditions

Efforts across the nation to lower the incidence of MVA injuries and fatalities have traditionally focused on enforcement and education. Current models of intervention generally seek to enforce traffic safety laws and educate individuals on restraint system use and DWI (Braver, 2003; Dinh-Zarr et al., 2001; Elder et al., 2004; Elder et al., 2005; Harper, et al., 2000; Romano, et al., 2005; Shults et al., 2001). The results of this study, however, indicate that environmental characteristics such as lighting and physical barriers play a major role in rural MVAs. While driver education and enforcement of laws covering behaviors such as seat-belt use are undoubtedly important to the reduction of rural MVAs, interventions and preventative measures must address the environmental conditions associated with rural MVAs.

Study Strengths and Limitations

While this study relied exclusively on secondary quantitative data that were incomplete for race/ethnicity, FARS data has several methodological advantages over other sources of data on traffic fatalities such as data from regional crash registries and trauma center records. FARS is not only a national source of data, but contains information related to individuals as well as environmental conditions. Because it contains multiple years of data, the FARS database provided enough data to undertake meaningful analyses of rural and urban MVAs in the Valley. It is likely that the findings of this research will provide a valuable framework for further research and a deeper understanding of rural MVA injuries and fatalities.

Two potential additional limitations exist: 1) uncertainty about classifying variables and accurately understanding driver, setting, and driver-setting interactions and 2) lack of coding for

each event in order to understand the concentration of events (e.g., the importance of rural roads in general versus particular predictable confluences of use patterns and road conditions).

Implications for Future Work

Further research is needed to examine the relative roles of drivers, environmental conditions, and their interactions in rural MVAs. Community-based participatory research would give residents of rural communities an opportunity to be involved in the identification and implementation of solutions well-matched to their unique communities. Greater understanding of the social costs of rural MVAs would be useful to the development of effective policies and interventions. In particular, insight into the driving patterns of rural drivers and the capability and/or resources of rural communities to process losses associated with MVA fatalities would be beneficial.

Next Steps: Community Advocates for Rural Safety (CARS)

Short and long term plans have been developed to address MVA fatalities in the SJV in two phases.

Phase One consists of pilot projects in a total of four communities in two separate counties with the goal of understanding and planning solutions to MVA inequities and their underlying causes. Teams (called Community Advocates for Rural Safety or CARS) consisting of community residents, community based organizations, and decision- makers will be engaged in identifying the social determinants and immediate causes of MVAs in their communities and developing and implementing plans to address these challenges.

This project will promote community engagement in identifying the root causes of rural MVAs and developing solutions in coordination with local community agencies that work to improve mobility and safety. Under-represented, low-income residents from both incorporated

and unincorporated communities will be the focus of recruitment. Unincorporated communities with low-income, minority residents are often systematically underserved in the allocation of public resources and consequently have deficiencies in all kinds of physical infrastructure, including housing, human services, and health care. Government structures to ensure meaningful political representation in decision-making are also lacking in such communities and, as shown by this research, MVA fatality rates are higher due to poor road conditions. The overall plan of the project, therefore, is to reduce the amount of MVAs in rural communities that have elevated MVA rates by engaging citizens in direct participation and discussions about causes and solutions and creating partnerships between community groups and local agencies.

Planned activities include:

- The development of an MVA Task Force and community-lead advocacy groups to collaborate on articulating feasible regional, county, local government and private sector actions to address MVA inequalities and their social determinants
- The identification of rural community residents whose lives have been touched by MVAs, who will be engaged (along with other stakeholders) in forming CARS groups for advocacy and implementation planning
- Work with community-based organizations and community advocates in identifying, planning, and seeking implementation of recommended actions, in part through qualitative research

Phase Two focuses on the replication of the best features of the pilot project in three or more rural and unincorporated communities in each of the Valley's eight counties. We will continue the expansion and development of the MVA Regional Task force, as well as recruit CARS leaders from Phase One pilot project communities to mentor emerging community

development groups in nearby communities and create opportunities for shared learning for CBO staff and residents in each participating Phase Two community.

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INDIVIDUAL COUNTY ANALYSIS

Discriminant analyses for four of the six participating counties did not meet the criteria for classification accuracy for any of the three models (cross-validated classification were not 25% or higher than the proportional by chance accuracy rate). In other words, there was not a significant difference in the rural/urban classification to complete the discriminant analysis Therefore, only chi square analyses are presented for for Kings, Madera, Merced, and Tulare counties.

Kings County

Rural and urban MVAs differed in Kings County for driver characteristics and environmental characteristics, but not for driver behaviors. Significant driver characteristics included previous DWI convictions and previous suspensions/revocations. The only environmental condition more frequent in rural than urban MVAs was a lack of lighting.

Table 4. Driver Characteristics and Behaviors: Kings Count Results from Chi Square y, N = 238

Driver Characteristic or Behavior	**% Urban**	**% Rural**	**p ≤**
Urban			
Driver with 1 or More DWI Conviction(s) within 3 Years Prior to Accident	**15**	5	.05
Driver with 1 or More Suspension(s)/ Revocation(s) within 3 Years Prior to Accident	**24**	10	.05

Table 5. Environmental Characteristics: Kings County Results from Chi Square, N = 140

Environment/Road Characteristics	**% Urban**	**% Rural**	**p ≤**
Urban			
Collision with Pedestrian or Pedal Cyclist	**44**	4	.001
Dark Roadway with Lighting	**32**	10	.01
Rural			
Collision with 1 or More Other Vehicles	24	**60**	.001

Madera County

Madera County MVAs differed significantly for rural and urban areas on driver characteristics, driver behaviors, and environment. Driver variables that were found more frequently in rural areas were previous speeding convictions and suspensions/revocations, receiving a speeding violation at the time of the accident, and higher traveling speeds. Environmental conditions more common to rural areas included a lack of lighting.

Table 6. Driver Characteristics and Behaviors: Madera County Results from Chi Square, N = 224

Driver Characteristic or Behavior	**% Urban**	**% Rural**	**p ≤**
Urban			
Driver with 1 or More Speeding Conviction(s) within 3 Years Prior to Accident	**29**	13	.05
Driver with 1 or More Suspension(s)/ Revocation(s) within 3 Years Prior to Accident	**29**	13	.05
Driver Received Violation for Speeding	**11**	1	.05
Rural			
Travel Speed Greater than 55mph	4	**36**	.001

Table 7. Environmental Characteristics: Madera County Results from Chi Square, N = 148

Environment/Road Characteristics	**% Urban**	**% Rural**	**p ≤**
Urban			
Collision with Pedestrian or Pedal Cyclist	**59**	10	.001
Dark Roadway with Lighting	**32**	2	.001
Rural			
Dark Roadway with No Lighting	9	**38**	.01
Collision with 1 or More Other Vehicles	5	**51**	.05

Merced County

In Merced County, driver characteristics, driver behaviors, and environmental characteristics were found to differ significantly for urban and rural accidents. Driver variables included previous accidents, traveling speed, driving mistakes and mistake violations. Environmental characteristics that were significantly different were lighting and road surface type, with more lighting and asphalt roads in urban areas.

Table 8. Driver Characteristics and Behaviors: Merced County Results from Chi Square, N = 294

Driver Characteristic or Behavior	**% Urban**	**% Rural**	**p ≤**
Urban			
Driver Reported as Making Driving Mistake (i.e., Unsafe Lane Change, Improper Passing)	**56**	41	.05
Driver with 1 or More Accident(s) within 3 Years Prior to Accident	**35**	20	.05
Rural			
Travel Speed Greater than 55mph	16	**40**	.001
Driver Received Violation for Driving Mistake (i.e., Improper Turns or Passing)	0	**7**	.05

Table 9. Environmental Characteristics: Merced County Results from Chi Square, N =203

Environment/Road Characteristics	**% Urban**	**% Rural**	**p ≤**
Urban			
Collision with Pedestrian or Pedal Cyclist	**60**	13	.001
Dark Roadway with Lighting	**28**	6	.001
Roadway Made of Asphalt	**100**	92	.05
Rural			
Collision with 1 or More Other Vehicles	15	**44**	.001
Non-Collision, Including Rollovers	13	**34**	.01

Latinos accounted for almost half (865) of the 1,855 total fatalities and were found to be significantly more involved in rural accidents than in urban (x^2 [1, N = 1846] = 13.851, p <.001). Latinos and non- Latino whites were by far the most frequent fatalities in the six counties (90.46% of all fatalities); non-whites accounted for 162 fatalities of the 1,855 between 2001 and 2004.

Table 10. Urban and Rural Differences in MVAs, Results from Discriminant Analysis, N= 1676

	Urban Mean	Rural Mean	Mean Difference	Total Mean
Urban				
Collision with Pedestrian or Pedal Cyclist	**.36**	.09	.27***	.18
Dark Roadway with Lighting	**.27**	.04	.23***	.11
Intersection or other Junction	**.38**	.23	.15***	.28
Air Bag Available/Functional	**.56**	.49	.07***	.51
Two-Way Road with Physical Barrier	**.08**	.01	.07***	.03
Driver Inattentive (i.e., Eating, Fatigue, Cell Phone Use)	**.15**	.10	.05***	.11
More than 4 Vehicle Occupants	**.14**	.11	.03***	.12
Non-Adverse Weather (i.e., Rain or Fog)	**.96**	.93	.03***	.94
Rural				
Travel Speed Greater than 55mph	.19	**.37**	.18***	.31
Non-Collision, Including Rollovers	.14	**.31**	.17***	.26
Dark Roadway with No Lighting	.22	**.37**	.15***	.32
Speed Limit Over 45mph	.69	**.80**	.11***	.77
Collision with 1 or More Other Vehicles	.37	**.47**	.10***	.44
1 or More Violations Charged	.13	**.20**	.07***	.18
Weekend (Friday through Sunday)	.46	**.53**	.07***	.51

***p< .001

Tulare County

Driver characteristics, driver behaviors, and environmental characteristics were found to differ significantly for urban and rural accidents in Tulare County. Significant driver characteristics included having an older vehicle and previously recorded accidents. Driver behaviors included driving recklessly, receiving a DWI violation at the time of the accident, being charged with a violation of any kind, driving on weekends, and higher traveling speeds. Lack of lighting and physical barriers, along with higher speed limits, distinguished rural accidents from urban.

Table 11. Driver Characteristics and Behaviors: Tulare County Results from Chi Square, N = 553

Driver Characteristic or Behavior	**% Urban**	**% Rural**	**p ≤**
Urban			
Driver Operating Vehicle in Erratic, Reckless, or Negligent Manner	**4**	.7	.01
Driver with 1 or More Accident(s) within 3 Years Prior to Accident	**21**	14	.05
Rural			
Travel Speed Greater than 55mph	18	**33**	.001
Vehicle More Than 10 Years Old	25	**36**	.01
Accident Occurred on Friday, Saturday or Sunday	39	**50**	.05
Driver Received 1 or More Violation(s) at Time of Accident	7	**13**	.05
Driver Received Violation for DWI at Time of Accident	4	**8**	.05

Table 12. Environmental Characteristics: Tulare County Results from Chi Square, N = 362

Environment/Road Characteristics	**% Urban**	**% Rural**	**p ≤**
Urban			
Collision with Pedestrian or Pedal Cyclist	**28**	13	.001
Dark Roadway with Lighting	**30**	6	.001
One-Way Road	**3**	0	.05
Two-Way Road with Physical Barrier	**3**	0	.05
Rural			
Two-Way Road with No Physical Barrier	92	**99**	.001
Dark Roadway with No Lighting	23	**39**	.01
Speed Limit Over 45mph	72	**84**	.05

Discriminant analysis was successful for Fresno and Kern counties and results are presented in the Tables 13 and 14 below. The last model (which included driver characteristics, driver behaviors, and environmental characteristics) accounted for 27.25% of the variance in Fresno County [x^2 (14, N = 932) = 279.833, p< .001, R^2 = .522] and 72% of the accidents were correctly classified. For Kern County, 29.81% of the variance between the two groups was accounted for by the last model [x^2 (13, N = 805) = 263.500, p< .001, R^2 = .546] and 73.6% of the accidents were correctly classified.

Fresno County

Significant driver characteristic variables for rural accidents in Fresno County included vehicles without airbags and drivers without a valid license. Drivers with previous license suspensions/revocations were more common in urban MVAs. Driver behaviors associated with rural accidents included DWI, weekends, and speeding. Rural accidents differed from urban in their lack of lighting, signs, and barriers, as well as roads with a greater number of travel lanes.

Table 13. Urban and Rural Differences in MVAs, Results from Discriminant Analysis for Fresno County, N = 932

	Urban Mean	Rural Mean	Mean Difference	Total Mean
Urban				
Dark Roadway with Lighting	**.29**	.03	.26***	.16
Collision with Pedestrian or Pedal Cyclist	**.22**	.08	.14***	.14
Air Bag Available/Functional	**.56**	.45	.11***	.50
Traffic Sign or Signal	**.44**	.36	.08***	.39
Two-Way Road with Physical Barrier	**.08**	.00	.08***	.03
Valid Driver's License	**.78**	.71	.07***	.74
Driver with 1 or More Suspension(s)/ Revocation(s) within 3 years Prior to Accident	**.20**	.13	.07***	.16
Road with More than 2 Travel Lanes	**.13**	.06	.07***	.09
Driver Reported as DWI	**.19**	.16	.03***	.17
Non-Adverse Weather	**.97**	.94	.03***	.95
Rural				
Dark Roadway with No Lighting	.16	**.36**	.20***	.28
Accident Occurred on Friday, Saturday or Sunday	.42	**.50**	.08***	.46
Driving Over the Speed Limit by 1mph or More	.08	**.10**	.02***	.09

***p< .001

Kern County

Rural accidents in Kern County were different from urban in driver characteristics (non-valid license, vehicles older than ten years, males, and drivers over the age of 30) and behaviors (higher travelling speeds and more than four vehicle occupants). Rural accidents were more often at non-junctions, in adverse weather, and on roads without barriers, signs, and/or lighting.

Table 14. Urban and Rural Differences in MVAs, Results from Discriminant Analysis for Kern County, N = 805

	Urban Mean	**Rural Mean**	**Mean Difference**	**Total Mean**
Urban				
Intersection or other Junction	**.44**	.17	.27***	.28
Traffic Sign or Signal	**.41**	.17	.24***	.27
Collision with Pedestrian or Pedal Cyclist	**.24**	.05	.19***	.13
Dark Roadway with Lighting	**.21**	.02	.19***	.10
Two-Way Road with Physical Barrier	**.13**	.05	.08***	.08
Valid Driver's License	**.82**	.76	.06***	.78
Non-Adverse Weather	**.96**	.93	.03***	.94
Rural				
Travel Speed Greater than 55mph	.19	**.45**	.26***	.34
Speed Limit Over 45mph	.71	**.78**	.07***	.75
Driver Thirty Years Old or Older	.58	**.65**	.07***	.62
Vehicle More Than 10 Years Old	.25	**.31**	.06***	.74
Male	.71	**.76**	.05***	.74
More than 4 Vehicle Occupants	.04	**.07**	.03***	.05

***p< .001

<u>The Inclusion of Ethnicity Does Not Improve Discrimination in Rural and Urban MVAs in the San Joaquin Valley</u>

Results from the discriminant analyses of the sub-sample for which ethnicity data was available indicated that, while significantly more Latinos die in rural accidents than in urban in the San Joaquin Valley; Latino ethnicity did not significantly improve the discrimination between rural and urban MVAs. As shown in Table 13, the variables identified as important in

the analysis of the race/ethnicity sub-sample were similar to those identified as important in the larger dataset of drivers and results did not differ when the ethnicity variable was removed from the analysis.

Table 15. Results from Discriminant Analysis of Ethnicity Subsample

	Ethnicity Entered			**Ethnicity Omitted**		
Variable	**Urban Mean**	**Rural Mean**	**r**	**Urban Mean**	**Rural Mean**	**r**
Dark Roadway with Lighting***	**.21**	.03	.702	**.21**	.03	.715
Two-Way Road with Physical Barrier***	**.09**	.01	.454	**.09**	.01	.462
Intersection or other Junction***	**.37**	.22	.352	**.37**	.22	.358
Dark Roadway with No Lighting***	.20	**.35**	-.347	.20	**.35**	-.354
Travel Speed Greater than 55mph **	.22	**.30**	-.188	.22	**.30**	-.191
Latino**	.34	**.43**	-.200			
x^2	(14, N = 1036) = 170.511			(14, N = 1036) = 164.907		
p	< .001			< .001		
R^2	**.391**			**.385**		
% classified correctly	77.6			77.6		

**p<.01

***p<.001

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