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How Does Diabetic Eye Disease Affect the American Worker?

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BACKGROUND

- Diabetes affects 8.3% of the US population (25.8 million people), 7.0 million of whom are undiagnosed.[1]
- In 2012, the total estimated direct medical costs and costs due to reduced productivity associated with diagnosed diabetes were $176 billion and $69 billion, respectively.[2]
- The risk of developing diabetic retinopathy (DR) and diabetic macular edema (DME) is increased in individuals with type I or type II diabetes mellitus.
  - In the US, diabetes is the main cause of new blindness cases in adults aged 20–74 years.[1]
- This study assessed the impact of DME and DR on absence from work and health expenditures in US employees, including commercial drivers, for whom good vision is vital to maintain employment.[3]

PURPOSE

- To compare the annual health benefit costs and absence days in Commercial Drivers and Non-driver US employees with DME, DR, diabetes, or Controls without diabetes.

METHODS

Study Design

- Retrospective regression-based analysis using the HCMS Research Reference Database (RRDb), Cheyenne, WY.

Research Population and Cohort Definitions

- Included subjects were sourced from a population of employees whose demographic, payroll, health insurance, health-related work absence, and Workers Compensation data were maintained in the RRDb.
- Employee data were sourced from >20 geographically dispersed US employers (>1.7 million employees); all subjects were employed at some point between January 1, 2001 and June 30, 2012.
- Employees with DR, DME, or diabetes were classified into 4 study cohorts based on driver classification (Driver or Non-driver) and any primary, secondary, or tertiary International Classification of Diseases Ninth Revision (ICD9) codes as follows:
  - DME: ICD-9's (362.07) or [(362.53 or 362.83) and 250.xx]
  - DR: ICD-9's 362.0x, but without DME
  - Diabetes: ICD-9's 250.xx but without DME or DR
  - Control: without DME, DR, or diabetes.
- All 4 study cohorts were compared within the Driver and Non-driver populations.
- The date of the initial claim was the index date for the DME and DR cohorts.
- For the Diabetes and Control cohorts, the index date was the average index dates of the DME and DR cohorts (by company).
- Subjects were required to be in continuous employment and health plan enrollment for a 12-month study period after the index date; costs and absence days were measured in the year after each employee's index date.
- Only subjects who were eligible and enrolled in the appropriate leave plan during the study period were included in the models for that benefit.

Employee Absenteeism (Lost Days)

- Absenteeism data were sourced from employer payroll records and disability and compensation claims records.
- Absence from work included days lost due to sick leave, short- and long-term disability, and Workers Compensation.

Health Benefit Costs

- Health benefit cost components were derived from different benefits provided by employers to employees:
  - Direct components, including medical (healthcare) costs and prescription costs.
  - Indirect components, including payments made by the employer to the employee for absences due to sick leave, short- and long-term disability, and Workers Compensation.

Inflation Adjustments

- Annual direct and indirect cost outcomes were inflation-adjusted to June 2012 US dollars by the appropriate component of the Bureau of Labor Statistics (BLS) Consumer Price Index (CPI):
  - Medical Cost components: The Medical services CPI
  - Prescription drug cost components: Prescription Drugs CPI
  - All other cost elements: All Consumer Goods CPI.

Statistical Analysis

- Non-regression based statistical tests compared the demographics of the cohorts included in the analysis:
  - Tukey-Kramer *t*-tests were used to determine if differences in continuous demographic characteristics were statistically significant ($P<0.05$).
  - Marascuillo-adjusted chi-squared tests were used to determine the significance of differences between dichotomous demographic variables.
- Two-part regression modeling was used to estimate each outcome in the analysis:
  - Logistic regression was used to model the likelihood of an outcome >0 (eg, those with a disability claim vs. those without).
  - Generalized linear models (GLMs) were used to estimate costs or absence days for the proportion of the population with an outcome >0.
- Stepwise selection methods were used in all models to determine the variables to be included in the final model.
- Independent variables, including demographics and job-related information, were used to control for confounding factors between cohorts; sick leave models also controlled for employer.

RESULTS

Descriptive Statistics of Drivers and Non-drivers

- Descriptive statistics for the 39,702 commercial Drivers and 426,549 Non-drivers included in this analysis are shown in **Table 1** and **Table 2**, respectively.

Table 1. Descriptive statistics for the Driver populations

	DME (n=26)		DR (n=103)		Diabetes (n=1191)		Control (n=38,382)	
Variable	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Age (index Dx date), years	46.87[c]	1.72	48.93[b,c]	0.93	46.53[c]	0.25	39.05	0.04
Tenure (index Dx date), years	5.97[a,b]	1.12	11.40[c]	0.89	10.78[c]	0.23	8.41	0.03
Female, %	3.8[c]	3.8	3.9[c]	1.9	5.1[c]	0.6	17.0	0.2
Marital status, %								
Married	65.4	9.5	66.0	4.7	65.7[c]	1.4	59.8	0.3
Not married	30.8	9.2	16.5[c]	3.7	26.5[c]	1.3	37.6	0.2
Missing	3.8	3.8	17.5[c]	3.8	7.7[c]	0.8	2.6	0.1
Race/ethnicity, %								
White	61.5	9.7	38.8[c]	4.8	51.5[c]	1.4	62.8	0.2
Black	23.1	8.4	39.8[c]	4.8	31.6[c]	1.3	21.6	0.2
Hispanic	15.4	7.2	16.5	3.7	14.2	1.0	12.7	0.2
Other	0.0[b,c]	0.0	2.9	1.7	2.0	0.4	2.5	0.1
Missing	0.0[b,c]	0.0	1.9	1.4	0.8	0.3	0.4	0.0
Exempt employee, %	0.0[c]	0.0	0.0[c]	0.0	0.3%	0.1	0.5	0.0
Annual salary, $	35,463	1,383	36,569	690	37,164	211	35,016	244
Full-time employment, %	96.2[c]	3.8	96.1[b,c]	1.9	89.3[c]	0.9	78.2	0.2
Charlson Comorbidity Index	2.42[a,b,c]	0.23	3.26[b,c]	0.12	1.58[c]	0.03	0.09	0.00

[a] $P<0.05$ vs. DR cohort, adjusting for multiple comparisons between cohorts using the Tukey-Kramer procedure for continuous variables or the Marascuilo procedure for binary variables.
[b] $P<0.05$ vs. Diabetes cohort, adjusting for multiple comparisons between cohorts using the Tukey-Kramer procedure for continuous variables or the Marascuilo procedure for binary variables.
[c] $P<0.05$ vs. Control cohort, adjusting for multiple comparisons between cohorts using the Tukey-Kramer procedure for continuous variables or the Marascuilo procedure for binary variables.
DME = diabetic macular edema; DR = diabetic retinopathy; Dx = diagnosis; SE = standard error.

Table 2. Descriptive statistics for the Non-driver populations

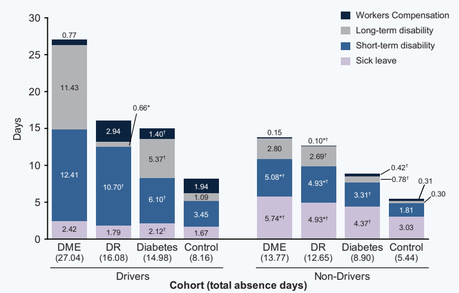
	DME (n=538)		DR (n=1441)		Diabetes (n=18,639)		Control (n=405,931)	
Variable	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Age (index Dx date), years	50.43[b,c]	0.41	49.14[c]	0.27	48.90[c]	0.07	40.83	0.02
Tenure (index Dx date), years	11.74[c]	0.46	12.20[c]	0.28	12.22[c]	0.07	8.87	0.01
Female, %	46.7	2.2	46.5	1.3	48.7	0.4	48.3	0.1
Marital status, %								
Married	36.8	2.1	38.0[b]	1.3	42.1[b]	0.4	36.4	0.1
Not married	24.2[b,c]	1.8	27.6[b,c]	1.2	31.4[b]	0.3	33.0	0.1
Missing	39.0[b,c]	2.1	34.5[b,c]	1.3	26.4[b]	0.3	30.5	0.1
Race/ethnicity, %								
White	33.1	2.0	31.8	1.2	33.3[c]	0.3	35.0	0.1
Black	13.2	1.5	11.5	0.8	13.7[c]	0.3	9.3	0.0
Hispanic	8.2	1.2	11.4[b,c]	0.8	7.5[c]	0.2	5.4	0.0
Other	3.0	0.7	3.5	0.5	3.9	0.1	3.6	0.0
Missing	42.6	2.1	41.9[c]	1.3	41.6[c]	0.4	46.7	0.1
Exempt employee, %	27.7[c]	1.9	30.7[c]	1.2	29.3[c]	0.3	36.2	0.1
Annual salary, $	50,160	1,360	54,680	933	52,557[c]	250	56,972	143
Full-time employment, %	97.8[b,c]	0.6	97.4[b,c]	0.4	95.9[c]	0.1	93.1	0.0
Charlson Comorbidity Index	2.89[a,b,c]	0.07	3.41[b,c]	0.03	1.72[c]	0.01	0.15	0.00

[a] $P<0.05$ vs. DR Cohort, adjusting for multiple comparisons between cohorts using the Tukey-Kramer procedure for continuous variables or the Marascuilo procedure for binary variables.
[b] $P<0.05$ vs. Diabetes Cohort, adjusting for multiple comparisons between cohorts using the Tukey-Kramer procedure for continuous variables or the Marascuilo procedure for binary variables.
[c] $P<0.05$ vs. Control Cohort, adjusting for multiple comparisons between cohorts using the Tukey-Kramer procedure for continuous variables or the Marascuilo procedure for binary variables.
DME = diabetic macular edema; DR = diabetic retinopathy; Dx = diagnosis; SE = standard error.

Comparisons of Absence Days

- For both Drivers and Non-drivers, the total number of absence days was greatest in the DME cohort, followed by the DR, Diabetes, and Control cohorts (**Figure 1**).

Figure 1. Annual absence days (Drivers and Non-drivers).



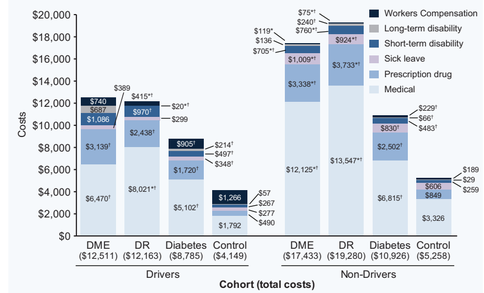
Within drivers and non-drivers only:
* $P<0.05$ vs. diabetes.
† $P<0.05$ vs. controls.
DME = diabetic macular edema; DR = diabetic retinopathy.

- The most common reason for employee absenteeism in the DR and DME cohorts was short- and long-term disability among Drivers, and sick leave and short-term disability among Non-drivers.
- Differences between the disease cohorts and Controls were generally larger within the Driver population.
- In the Non-driver population, sick leave and short-term disability were significantly different in all cohort pairs, except DME vs. DR ($P<0.03$).
- All employee absence categories for Drivers in the Diabetes cohort were significantly different vs. the Control cohort ($P<0.004$).
- No significant differences were reported between the DME and DR cohorts in either the Driver or Non-driver populations.

Comparisons of Annual Health Benefit Costs

- Total annual health benefit costs in Drivers with DME, DR, or Diabetes were $12,511, $12,163, and $8,785, respectively (**Figure 2**).
- In the Driver population, direct medical costs (medical and prescription drug) were significantly higher in employees in the DME, DR, or Diabetes cohorts vs. Controls ($P<0.02$).
- In the Non-driver population, sick leave, short- and long-term disability, and Workers Compensation were significant ($P<0.05$) in all cohort pairs except DME vs. DR.
- No comparisons between the DR and DME cohorts were significant in either the Driver or Non-driver populations.

Figure 2. Annual direct and indirect health benefit costs (Drivers and Non-drivers).



Within drivers and non-drivers only:
* $P<0.05$ vs. diabetes.
† $P<0.05$ vs. controls.
DME = diabetic macular edema; DR = diabetic retinopathy.

LIMITATIONS

- The study design did not allow for direct comparisons between the Driver and Non-driver populations.
- Driver DME and DR cohort sizes were small, which resulted in few significant differences compared with the Driver Diabetes and Control cohorts.
- While all included employees had medical or drug eligibility, the eligibility for indirect components varied by element. Therefore, there was no direct method to calculate the significance of the total costs or total absence days.

CONCLUSIONS

- This analysis shows the detrimental impact of DME and DR on employee absenteeism, particularly those employees who depend on good eyesight in their profession.
- Compared with Controls, commercial drivers with DME or DR were $8,362 and $8,014 more expensive, respectively.
- These analyses will provide employers with the necessary information to assess the impact of DME and DR on employees, and provide insight into the importance of treatment for these conditions.

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