Wachler BSB and Wachler MB, J Ophthalmic Clin Res 2018, 5: 038
DOI: 10.24966/OCR-8887/100038

HSOA Journal of Ophthalmology and Clinical Research

Research Article

Correlation of Side Window Ultraviolet A Radiation Protection with Price of Newer Automobiles

Brian S Boxer Wachler* and Micaela Boxer Wachler

Boxer Wachler Vision Institute, Beverly Hills, CA, USA

Abstract

Importance: Ultraviolet A (UVA) light relates to risk for cataract and skin cancer.

Objective: To correlate the level of UVA light protection in automobile side windows with vehicle price and assess protection in newer automobile side windows and windshields.

Design: Cross sectional study; thirty two cars from 21 car manufacturers were analyzed in this cross-sectional study. Outside ambient UVA radiation was measured along with UVA radiation behind the front windshield and behind the driver side window of all cars. The years of the cars ranged from 2014 to 2016.

Setting: Car dealerships in Los Angeles, California

Participants: Automobiles

Main Outcome and Measure: Amount of UVA blockage from windshields and side windows.

Results: Regression analysis between side window protection and vehicle year of manufacturer was r^2 = 0.04 (p=0.75). The average front windshield UVA blockage was 96%, range 92% to 99% (95% CI, 95.7%-96.3%) was higher than side window blockage which was 73%, range 61% to 97% (95% CI, 66.4%-75.6%). The difference between front windshield and side window UVA blockage was 23%. A high level of side window UVA blockage > 90% was found in 5 of 32 cars (15.6%).

Conclusion & Relevance: Side window UVA protection was highly variable and did not correlate with cost of automobile. Front windshield UVA protection was consistently high among cars. These results may in part explain the reported increased rates of cataract in left eyes and left-sided facial skin cancer. Automakers may wish to consider increasing the degree of UVA protection in vehicle side windows in all vehicles regardless of sales price.

***Corresponding author:** Brian S Boxer Wachler, Boxer Wachler Vision Institute, 465 N. Roxbury Drive, Suite 902, Beverly Hills, CA, USA, Tel: +1 3108601900; E-mail: bbw@boxerwachler.com

Citation: Wachler BSB, Wachler MB (2018) Correlation of Side Window Ultraviolet A Radiation Protection with Price of Newer Automobiles. J Ophthalmic Clin Res 5: 38.

Received: August 31, 2017; **Accepted:** January 23, 2018; **Published:** February 09, 2018

Introduction

In our previous study, we assessed the level of Ultraviolet A (UVA) radiation in side windows and front windshields of older automobiles. That study found average side window UVA blockage was 71% compared to 96% UVA blockage in front windshields [1]. The same study revealed that 13.7% of vehicles had side window UVA protection >90%. Automobile drivers have particular sun exposure to their left side, particularly faces and eyes, as their left side is adjacent to vehicle side windows. Prior studies have shown that UVA is linked to increased risk of cataract formation [2] and skin cancer [3]. Skin cancers are more common on the left side of the face [4,5]. Cataract formation is more common in left eyes where automobile drivers drive on right side of the road and expose the left side of their faces to the side window [6], however these results may be less pronounced than skin cancer differences.

Newer automobiles are often more technologically advanced than older automobiles including safety features. More expensive vehicles typically include more options compared to lower end vehicles. We performed this study to assess if there was a correlation with UVA light protection of side windows cost of vehicle as well as to assess the degree of UVA light protection in newer automobiles.

Experiment/Materials and Methods

This cross-sectional study was undertaken in the late morning and afternoon during a two week period between August 8-22, 2015 (cloudless days), when we visited a number of Los Angeles-based car dealerships. Dealerships were selected for their proximity as they all were clustered within approximately 7 miles. A variety of makes, models, and years of vehicle production were assessed. A handheld UVA light meter (Omega, Stamford, CT) was used to assess the amount UVA radiation. Test-retest reliability was previously evaluated and no measurement with this device differed by more than +/- 0.02 milliwatt/cm^2 [1]. We measured external ambient UVA levels (with the meter pointed in the direction of the sun for each measurement) for each subject car as we did not rely on a single measurement for all vehicles since ambient UVA changes during the day. Immediately following this measurement for a given subject car, the UVA meter was then held on the inside of the driver's side window for measurement and oriented in the direction of the sun. The UVA meter was then held immediately behind the driver's side of the front windshield for measurement pointed in the direction of the sun.

The percentage of UVA blockage for each car's front windshield and driver side window was calculated by subtracting the UVA energy measured behind the window from the outside UVA energy. That

figure was divided by the outside UVA energy. This fraction was converted to percentage by multiplying 100. Paired t-test was used to compare UVA blockage of front windshields and side windows and simple linear regression analysis was performed using two variables: Side window protection (dependent variable) and vehicle year (Stat view, SAS, Cary, NC) in order to assess if older cars had lower UVA protection as a possible result of aging UVA window films. Cost data was found on manufacturer's website to determine new vehicle cost.

Results

We analyzed 32 cars from 21 car manufacturers. The years of the cars ranged from 2014 to 2016. Most automobiles in this study were made in 2015; 84.3% of cars were made in 2015, 9.4% of cars were made in 2016 cars, and 6.3% of cars were made in 2014. The average front windshield UVA blockage was 96%, range 92% to 99% (95% CI, 95.5%-96.5%) was higher than side window blockage which was 74%, range 61% to 97% (95% CI, 70.4%-77.6%). The difference between these average percentages is 23% (95% CI, 19.4%-26.6% (P < 0.001). A high level of side window UVA blockage (> 90%) was found in 5 of 32 cars (15.6%).

Table 1 displays the cars analyzed in our study with the UVA measurements and percentages of UVA blockage. Figure 1 shows there was no correlation of vehicle cost and side window UVA protection (r^2= 0.10, P= 0.07). For 26 cars with MSRP (Manufacturer's Suggested Retail Price) under $70,000 there was also no correlation of vehicle cost and side window UVA protection (r^2= 0.02, P= 0.50) (Figure 2). Figure 3 shows for 17 cars with MSRP under $35,000 there was also no correlation of vehicle cost and side window UVA protection (r^2= 0.02, P= 0.62). Figure 4 shows the distribution of front windshield UVA blockage and the more variable distribution of side window UVA blockage for same vehicles.

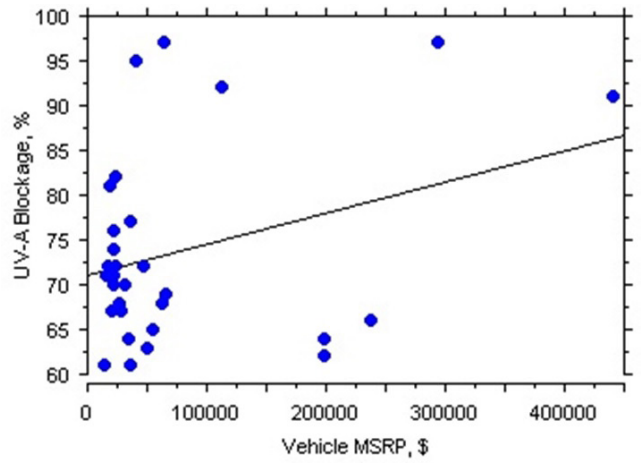

Figure 1: Distribution of vehicle cost and side window UVA.

Discussion

Cataracts have been found more in left eyes than right eyes [6,7]. Left sided skin facial cancers have been documented countries where cars are driven on the right side of the road [4,5] and in Australia (where cars are driven on the left side of the road and thus drivers right faces are exposed) the opposite was found; More skin cancer on the right side of the face [8].

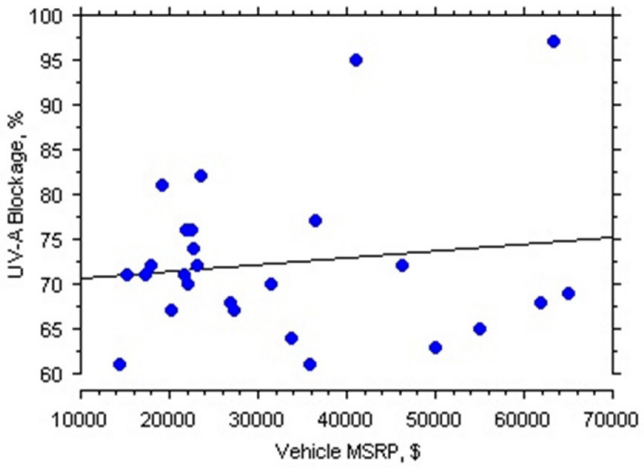

Figure 2: Distribution of 26 cars with MSRP under $70,000.

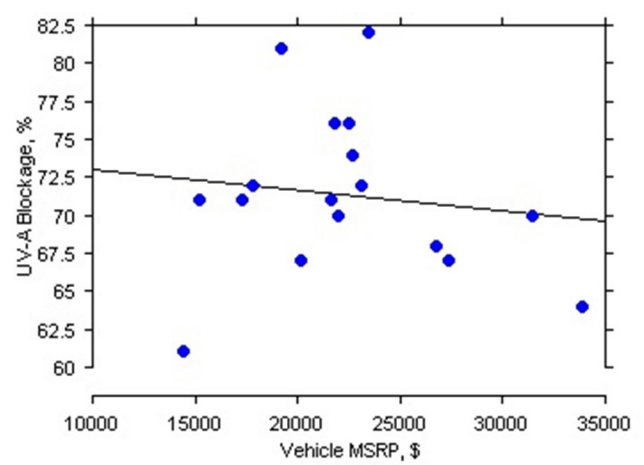

Figure 3: Distribution of 17 cars with MSRP under $35,000.

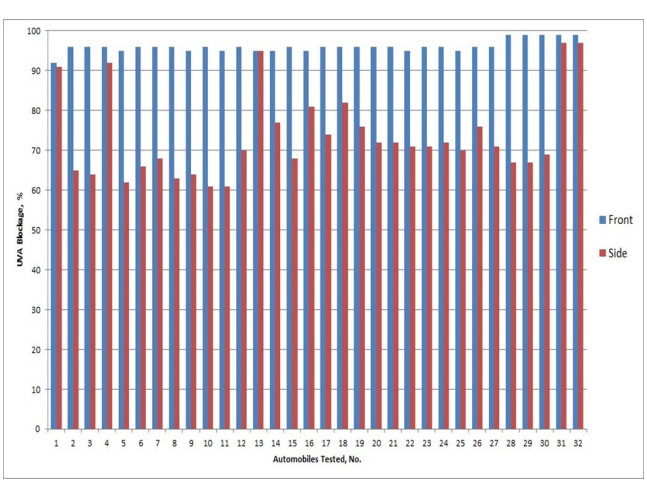

Figure 4: The distribution of front windshield UVA blockage compared to distribution of side window UVA blockage for same vehicles.

Car	Year	Model	Outside	Front	Side	blocked		Blocked	Blocked	Vehicle MSRP
						Front	Side Blocked	Front %	Side %	
			(milliwatt/cm2)	(milliwatt/cm2)	(milliwatt/cm2)	(milliwatt/cm2)	(milliwatt/cm2)			
Rolls Royce	2014	Phantom Drophead	2.69	0.21	0.25	2.48	2.44	92%	91%	$440,825
Chevrolet	2015	Corvette Stingray	2.8	0.11	0.98	2.69	1.82	96%	65%	$55,000
Ferrari	2014	California	2.8	0.12	1.01	2.68	1.79	96%	64%	$198,190
Mercedes	2015	ML63 AMG	2.6	0.11	0.22	2.49	2.38	96%	92%	$112,140
Ferrari	2015	California T	2.8	0.13	1.06	2.67	1.74	95%	62%	$198,973
Lamborghini	2015	Huracan	3.19	0.13	1.09	3.06	2.1	96%	66%	$237,250
Lincoln	2015	Navigator	2.81	0.1	0.89	2.71	1.92	96%	68%	$61,920
BMW	2015	528i sedan	2.75	0.1	1.02	2.65	1.73	96%	63%	$49,950
BMW	2015	M235i coupe	2.71	0.13	0.97	2.58	1.74	95%	64%	$33,845
Ford	2015	Fiesta	2.53	0.11	0.98	2.42	1.55	96%	61%	$14,455
Volvo	2015	XC60 T5	2.76	0.15	1.07	2.61	1.69	95%	61%	$35,750
Acura	2015	TLX	2.69	0.11	0.8	2.58	1.89	96%	70%	$31,445
Lexus	2015	RX350	2.6	0.12	0.12	2.48	2.48	95%	95%	$40,970
Lexus	2015	IS250 9502E	2.63	0.14	0.6	2.49	2.03	95%	77%	$36,550
Toyota	2015	Camry LE	2.69	0.12	0.86	2.57	1.83	96%	68%	$26,790
Scion	2015	tC	2.62	0.14	0.5	2.48	2.12	95%	81%	$19,210
Honda	2015	Civic EX-L	2.76	0.12	0.73	2.64	2.03	96%	74%	$22,640
Honda	2015	CR-V	2.76	0.11	0.5	2.65	2.26	96%	82%	$23,445
Chevrolet	2015	Malibu	2.78	0.12	0.68	2.66	2.1	96%	76%	$22,465
Chevrolet	2015	Tahoe	2.72	0.11	0.75	2.61	1.97	96%	72%	$46,300
Chevrolet	2016	Cruze LS	2.57	0.09	0.73	2.48	1.84	96%	72%	$17,845
Hyundai	2016	Elantra SE	2.51	0.13	0.74	2.38	1.77	95%	71%	$17,250
Hyundai	2015	Elantra Sport	2.54	0.11	0.74	2.43	1.8	96%	71%	$21,600
Jeep	2015	Cherokee	2.47	0.1	0.68	2.37	1.79	96%	72%	$23,095
Chrysler	2015	200	2.5	0.12	0.74	2.38	1.76	95%	70%	$21,995
Kia	2015	Optima LX	2.45	0.1	0.6	2.35	1.85	96%	76%	$21,840
Kia	2015	Soul +	2.45	0.09	0.7	2.36	1.75	96%	71%	$15,190
VW	2015	Beetle	3.31	0.04	1.09	3.27	2.22	99%	67%	$20,195
VW	2015	Golf TSI 2 door	3.28	0.04	1.09	3.24	2.19	99%	67%	$27,395
Jaguar	2016	F-type	3.64	0.04	1.14	3.6	2.5	99%	69%	$65,000
Land Rover	2015	Sport Super Charged	3.75	0.02	0.1	3.73	3.65	99%	97%	$63,350
Rolls Royce	2015	Wraith	3.44	0.02	0.1	3.42	3.34	99%	97%	$294,025

Table 1: Levels of UV-A light protection in automobile windshields, side windows and vehicle manufacturer suggested retail price.

This study found that there was no correlation between cost of vehicle and degree of driver's side window UVA protection. In other words, more expensive vehicles did not predictably provide greater UVA protection to drivers. Therefore consumers who purchase more costly cars should be aware that higher vehicle cost does not guarantee full UVA side window protection. Of the luxury models in table 1, Rolls Royce provided high UVA side window protection (91% and 97%) whereas Ferrari (64% and 62%) and Lamborghini (66%) were among the lowest of all cars in this study. The side window protection of a number of less expensive vehicles (while inadequate) such as Chevrolet, Hyundai, Scion, Toyota, Honda, Kia and VW were higher than some luxury cars such as BMW, Ferrari and Lamborghini.

As in my previous study [1], front windshields offered consistent protection for driver's eyes and faces against harmful effects of UVA light because of plastic within the windshield that provides UVA protection. Even in newer cars side windows on average had poor UVA protection. There was a large gap between windshield and driver's side window protection in newer cars as indicated by only 15.6% of cars had a high level (>90%) of side window UVA protection. Additionally a number of cars had a factory window tint on the side windows, but it did not guarantee increased UVA blockage.

There are limits to our study. While the number of models tested in this study were expanded from my previous study, all makes and

models were not evaluated. It is unknown that the degree of side window UVA protection is in makes and models not in this study.

This study found that there was no correlation in subject car's side window UVA protection with vehicle cost. This UVA exposure may increase the risk of cataract and skin cancer. Front windshields were found to have a high degree of UVA protection. It is prudent for drivers to reduce the UVA exposure by 1) Wearing sun block 2) Wearing sunglasses with a wraparound frame design and 3) Consider having a clear aftermarket UVA-blocking film added to their side windows. Automobile manufacturers may consider increasing the UVA protection of side windows to equal that of front windshields.

References

1. Boxer Wachler BS (2016) Assessment of levels of Ultraviolet A light protection in automobile windshields and side windows. JAMA Ophthalmol 134: 772-775.
2. Chylack LT Jr. (1984) Mechanisms of senile cataract formation. Ophthalmology 91: 596-602.
3. Chang C, Murzaku EC, Penn L, Abbasi NR, Davis PD, et al. (2014) More skin, more sun, more tan, more melanoma. Am J Public Health 104: 92-99.
4. Butler ST, Fosko SW (2010) Increased prevalence of left-sided skin cancers. J Am Acad Dermatol 63: 1006-1010.
5. Paulson KG, Iyer JG, Nghiem P (2011) Asymmetric lateral distribution of melanoma and Merkel cell carcinoma in the United States. J Am Acad Dermatol 65: 35-39.
6. Hirvela H, Luukinen H, Laatikainen L (1995) Prevalence and risk factors of lens opacities in the elderly in Finland. A population-based study. Ophthalmology 102: 108-117.
7. Abraham AG, Cox C, West S (2010) The differential effect of ultraviolet light exposure on cataract rate across regions of the lens. Invest Ophthalmol Vis Sci 51: 3919-3923.
8. Foley P, Lanzer D, Marks R (1986) Are solar keratosis more common on the driver's side? Br Med J (Clin Res Ed) 293: 18.