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Determinants of Medication Adherence to Topical Glaucoma Therapy

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Abstract

Introduction/Purpose—To determine the associations between medical, demographic, socioeconomic, and ocular factors and adherence to topical glaucoma ocular hypotensive therapy.

Methods—One-hundred and sixteen patients with ocular hypertension or open angle glaucoma from two tertiary glaucoma services participated in this prospective study. Adherence to ocular hypotensive therapy was measured using an electronic dose monitor (Travatan Dosing Aid, Alcon Laboratories Inc., Fort Worth, TX) and collected data at 3-months after enrollment. We used 3 different definitions of adherence: 1) *Definition 1*: the proportion of days taking the prescribed number of drops within 3 hours of the prescribed dosing time; 2) *Definition 2*: the proportion of days taking any drops within 3 hours of the prescribed dosing time; and 3) *Definition 3*: the proportion of days taking any drops within 6 hours of the prescribed dosing time. Univariate and multivariate models were used to determine the association between the three adherence definitions, medical, demographic, socioeconomic, and ocular factors at 3-month follow-up. The main outcome measures for this study were risk factors for poor objective medication adherence.

Results—Adherence, using *Definition 1, Definition 2,* and *Definition 3*, was 64%, 75%, and 80%, respectively. Age, total number of other eye diseases, and race were significantly associated with full treatment adherence (*Definition 1*), with race alone significantly predicting 11% of full treatment adherence. For *Definition 2*, age, income, level of education, and total number of eye diseases were significantly associated with partial adherence (3 hours), again race alone significantly predicted 15% of partial adherence (any drops within 3 hours). For *Definition 3*, race, income, level of education, and total number of other eye diseases significantly predicted partial adherence (any drops within 6 hours), both race and income predicted 19% of partial treatment adherence. Significant differences for adherence rates between patients of European descent and

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those of African descent were found for all three definitions with those who were less adherent more likely to be of African descent.

Conclusions—Electronic dose monitors provide important information regarding adherence to topical ocular hypotensive medications in glaucoma patients. Electronic dose monitors show low adherence in a significant number of participants. Future studies are needed to determine the reasons for these differences in health behaviors related to glaucoma treatment which should guide treatment of poor adherence with glaucoma therapy.

Keywords

medication adherence; compliance; glaucoma; Travapost; topical glaucoma therapy; Travatan; electronic dosing aids; health behaviors

Glaucoma is a leading causes of irreversible vision loss and blindness in the United States and is expected to affect 3 million persons in 2020.[1, 2] The most common form of glaucoma is primary open angle glaucoma (POAG) which requires long-term ocular hypotensive medical treatment.[3–5] More than 2 million people in the United States have POAG and that number is expected to exceed 3 million by 2020.[6] Multiple clinical trials demonstrate that lowering intraocular pressure with pharmacologic therapies reduces vision loss in ocular hypertension and glaucoma patients.[7–9] Thus, sustained and consistent patient adherence to ocular hypotensive medications is critical for delaying disease progression and vision loss. The public health challenge is that if detected and treated earlier with currently available ophthalmic treatments such as pressure-reducing eye drops, the disease process could be significantly delayed or possibly prevented, particularly for underserved populations who are at increased risk

Despite the availability of effective topical glaucoma therapies, the reality is that many patients do not use ocular hypotensives in the manner prescribed by physicians.[11, 12] Non-adherence in patients with glaucoma has been reported to range anywhere from 5% to 80% across 34 studies.[13] The majority of these studies relied largely on patient self-reported adherence or pharmacy claims data. These types of modalities have shortcomings in that they imply actual adherence behaviors and have been shown to be less accurate than measurements conducted using electronic monitoring devices.[14] With proper training and instruction, electronic dose monitoring devices such as the Travatan Dosing Aid (TDA) have been shown to reliably and accurately record eye drop administration as prescribed in order to more directly evaluate medication adherence.[15, 16]

Treatment adherence is a complex behavior and is influenced by many factors. Several studies suggest multiple reasons for poor adherence to glaucoma therapy.[17, 18] These include discomfort (e.g., stinging, burning, blurriness), frequency of administration, lack of obvious or immediate symptoms until later stages of glaucoma, age, motivation, education, health literacy, forgetfulness, and cost of the medications. These reasons represent four major factor types of barriers (medication regimen, patient factors, provider factors, and situation or environmental factors).[19–21] Self-reports from patients (questionnaires or structured interviews) and physician impressions often fail to predict whether or not patients will stay on treatment.[22] In contrast, electronic monitoring devices have been identified as the most accurate tool to evaluate adherence.[23] An advantage of electronic monitoring is the provision of information on the time and date of each dose to better assess adherence patterns versus relying on self-report data or physician impressions which are both subject to various biases (i.e., inaccurate memory, patient impression management, assumptions).

Increasing the proportion of people who adhere to topical glaucoma therapy may have a significant impact on the delay of the progression of the disease process, subsequent vision

loss and quality of life. However, before this objective can be achieved, we first need to better understand the complexity of the mechanisms underlying glaucoma medication adherence. While several studies in this area have recently been cited in the literature,[24, 25] limitations exist due to small samples sizes, lack of determinants studied along with their unique contribution to predicting adherence, homogeneity regarding the racial composition of the samples, and/or use of indirect outcome measures of adherence which only imply behavior patterns and medication usage (i.e., pharmaceutical claims data). Thus, greater knowledge regarding the range and unique contribution of risk factors and models for predicting poor adherence via direct methods are needed.[18, 26] This type of information will help inform the development of health-promotion interventions targeting relevant mechanisms associated with adherence. As such, the purpose of this study was to investigate the relationship between a comprehensive set of potential predictors and a direct measure of medication adherence (i.e., electronic dose monitor) to topical glaucoma therapy at 3-month follow-up. Compared to previous studies, this study is unique in the fact that we examined a large sample size, higher proportion of African Americans, 3 different definitions of direct adherence using an electronic dose monitor, and multiple determinants of adherence including demographic, medical, socioeconomic, and ocular factors using a prospective design.

Methods

Study Sites

This open-label, non-randomized cohort study was performed using patients from two independent, tertiary care glaucoma clinics. The Institutional Review Boards at the University of Alabama at Birmingham and Legacy Health System approved this study, and the study was in accordance with the provisions of the Declaration of Helsinki. The patients were aware that their adherence was being measured. They received a small monetary compensation for each study visit completed ($25.00 for baseline visit and $50.00 for 3-month follow-up visit).

Eligibility Criteria

To be eligible to participate in the study, patients had to be 1) 18 years or older; 2) have a diagnosis open-angle glaucoma (OAG) in one or both eyes or ocular hypertension (OHTN); and 3) using a prostaglandin ocular hypotensive medication in one or both eyes. The protocol excluded patients with uncontrolled intraocular pressure (IOP) control, known contraindications to Travoprost, clinically significant systemic disease that would interfere with the study, participation in any other research study within 30 days, or change in systemic medications that may alter intraocular pressure within 30 days before recruitment.

Study staff interviewed participants using a brief survey, which included age, gender, ethnicity, education, number of persons in the household, presence and number of other co-morbid chronic health conditions, presence and number of other ocular diseases, number of ocular medications, number of non-ocular medications, baseline intraocular pressure (IOP) of each eye, and severity of their visual field deviation in each eye. Income level was estimated from the number of people in the household and yearly amount of income based on the 2003 federal poverty level estimates.

After enrollment, study coordinators demonstrated to the subjects how to use the electronic dose monitor which allows only Travoprost bottles. Therefore, all subjects using a different prostaglandin analogue (such as Latanoprost or Bimatoprost) were switched to Travoprost. Travapost bottles along with the electronic dose monitor were provided free of charge to subjects. The study coordinators observed the subjects while they administered drops with

the electronic dose monitor to ensure comprehension of proper training in device usage and understanding of directions. They were instructed regarding the optimal technique.[15] The electronic dose monitor records the time and date when the participant depresses the lever. The coordinators asked the participants to administer their Travapost using the electronic dosing monitor according to their normal dosing schedule. Subjects brought their electronic dose monitor to the 3-month follow-up visit. Reminder calls were placed one day prior to the scheduled appointment. During the 3-month follow-up visit, information was downloaded from the electronic dose monitor, the battery was changed as necessary, and a brief series of questions were administered to estimate self-reported adherence and satisfaction with the device. The downloaded data was used to identify subjects' average proportion of days taking the prescribed medication within 3 hours of the prescribed time. A dose was considered dispensed if the lever of the electronic dose monitor was depressed and recorded within 3 hours of the routine dosing hour (prescribed time) for the appropriate number of eyes. When the lever was depressed outside of the time window, it was assumed that a does was not taken.

We examined 3 different definitions of objective adherence which represent strict to conservative definitions for adherence: 1) *Definition 1*: the proportion of days taking the prescribed number of drops within 3 hours of the prescribed dosing time; 2) *Definition 2*: the proportion of days taking any drops within 3 hours of the prescribed dosing time; and 3) *Definition 3*: the proportion of days taking any drops within 6 hours of the prescribed dosing time.

Statistical Analysis

Identification of risk factors for all three adherence definitions at the 3-month follow-up visit were initially evaluated using univariate predictors. Only significant demographic, medical, and ocular risk factors were included in the multivariate models. Three separate stepwise general linear models were computed to predict each of the medication adherence definitions. Significant risk factors were forward entered as a block for each model. Statistical significance was set at $p < .05$ (two-tailed). All analyses used the SPSS software Version 15.

Results

A total of 120 subjects were enrolled and 96% ($N = 116$) completed the 3-month follow-up visit. Reasons for incomplete 3-month data included withdrawing from the study due to side effects ($n = 2$) or not having the device at the time of the follow-up visit ($n = 2$). Table 1 describes the demographic, socioeconomic, medical, and ocular characteristics of the subjects who completed 3-month follow-up. A large proportion of subjects were either of African descent (41.4%, $n = 48$) or European descent (56%, $n = 65$). The average age of subjects was 64 years old ($SD = 13.73$, and the percentage of women who completed a 3-month follow-up visit was 56.9%; 43% were men. On average, subjects reported 1 other chronic health-related condition ($SD = 1.24$) and taking approximately 4 oral medications for problems other than vision ($SD = 3.16$). The most common health problems reported included hypertension (43.1%), arthritis (24.1%), diabetes (18.1%), cancer (12.9%), thyroid abnormalities (10.3%), coronary artery disease (10.3%), asthma (9.5%), seizures (2.6%), and emphysema (0.9%).

In terms of ocular characteristics, average baseline visual field mean deviation was −5.0 ($SD = 7.5$) for OD and −5.0 ($SD = 7.35$) for OS. The mean baseline intraocular pressure for OD was 17.65 ($SD = 6.1$) and 17.77 ($SD = 5.57$) for OS. Cataracts were the most frequent other eye disease reported by subjects (47.4%). An average of 3.5 drops per day ($SD = 2.18$) was reported by subjects taking eye drop medications at baseline, and the majority of the sample

reported they independently placed their eye drops in their eye (77.6%) and 12.1% reported requiring assistance (10.3% had missing data).

Adherence to Medication

Adherence using *Definition 1, Definition 2,* and *Definition 3* was 64%, 75%, and 80%, respectively. We examined whether intraocular pressure was associated with adherence. Using an ANOVA, there were no significant differences between IOP and any of the medication adherence definitions between baseline and 3-month follow-up.

Univariate and Multivariate Models of Treatment Adherence

Table 2 contains the univariate correlations between the significant risk factors and the 3 medication adherence definitions along with the multivariate predictor models for the significant univariate risk factors and the 3 objective medication adherence variables. Excluded from the analyses were subjects who were of Asian descent ($n = 2$) or "other" ($n = 2$) for race given the small sample sizes in each of the cells. Thus, for race, only those of European and African descent were included in the following analyses.

Predicting Definition 1: Full, Objective Medication Adherence

The univariate analysis showed younger age ($r = .20$, $p = .03$), African descent race ($r = .31$, $p = .001$), and greater number of eye diseases ($r = 22$, $p = .02$) were statistically associated with worse adherence using *Definition 1*. These variables served as candidate covariates for the multivariate model since they had statistical significance with the univariate analysis. At the multivariate level, race alone predicted full objective medication adherence. The model accounted for a significant amount of variance ($R^2 = .11$, $p < .001$).

Predicting Definition 2: Partial Medication Adherence (any drops within 3 hours of prescribed dosing time)

At the univariate level, several significant risk factors were associated with poor partial treatment adherence including age ($r = .20$, $p = .04$), race ($r = .33$, $p < .001$), level of household income ($r = .24$, $p = .02$), level of education ($r = .23$, $p = .02$), and other eye diseases ($r = .24$, $p = .009$). These variables served as candidate covariates for the multivariate model since they had statistical significance with the univariate analysis. Again, at the multivariate level, race alone predicted partial objective medication adherence. The model accounted for a significant amount of variance ($R^2 = .11$, $p < .001$).

Predicting Definition 3: Partial Medication Adherence (any drops within 6 hours of prescribed dosing time)

Several risk factors were associated with poor partial adherence using the definition of any drops within a 6 hour time frame and included race ($r = .27$, $p = .003$), level of household income ($r = .32$, $p = .02$), level of education ($r = .31$, $p = .001$), and other eye diseases ($r = .20$, $p = .03$). These variables served as candidate covariates for the multivariate model since they had statistical significance with the univariate analysis. For the final multivariate model, race and income significantly predicted partial objective medication adherence. The model accounted for a significant amount of variance ($R^2_{inc} = .19$, $p < .04$).

Discussion

African descent, level of education, income, younger age, and number of other eye conditions were associated with a direct measure of adherence in this prospective study. Race appeared to be a significant and consistent predictor accounting for the highest proportion of variance across adherence definitions. The present study was unique in that it

permitted an examination of a large sample size, higher proportion of patients of African descent, three definitions of adherence strictness, examined the unique contribution of multiple determinants in predicting adherence, and used an electronic dose monitor which is a powerful tool to objectively assess adherence. The majority of the sample was prescribed Travatan drops, therefore, it is unlikely that other eye drops influenced the results with the Travatan Dosing Aid. Overall adherence ranged from 64% to 80% for the sample and probably overestimates actual rates given that medication was provided free of cost. Regardless, these percentages indicate that efforts are needed for improving adherence, particularly among those of African descent and those with low income.

The disparity in adherence between patients of African descent and those of European ancestry was evident in this study. Patients of African descent demonstrated poorer adherence for all three definitions. This finding is particularly important as persons of African descent are at a much greater risk for developing glaucoma in general. Reasons for this difference are unclear but this finding warrants follow-up investigations designed to elicit reasons for this disparity. Interestingly, socioeconomic income was also related to one of the more liberal definitions of adherence despite the fact that medications were provided at no cost to patients. Even though cost was not an issue in this study, patterns of adherence differed for those patients, who in general, were disadvantaged economically. The reasons for this difference can only be speculated at this point. However, it may be likely that patients from more disadvantaged households who were at or below the federal poverty level had other more immediate or pressing stressors that preoccupied their time versus attention to daily routines associated with their health care. For example, given the asymptomatic nature of glaucoma, this may have been less of an immediate concern compared to managing other more basic needs vital to survival (i.e., getting basic physical needs met such as food, water, clothing; safety; security). Daily adherence to health may be less of concern or of secondary concern until basic needs are met. These findings related to socioeconomic determinants and poor adherence might have been more pronounced had cost been a factor. Thus, the importance of these factors should be taken into consideration for treatment decisions.

It should be noted that adherence did not appear to influence IOP. This may be due to the diurnal fluctuations in IOP in general and/or possible temporary increases in eye drop administration behavior by patients prior to their designated visits as they were aware their behaviors were being monitored. As such, such behavior may have arbitrarily impacted their IOP on the day of the designated visit.

Directions for Future Glaucoma-Related Studies on Adherence

These results demonstrate the need for further understanding other risk factors and mechanisms which may be contributing to race disparities in medication adherence among patients using topical glaucoma therapy. Risk factors such as race and income only partially explain the observed differences in glaucoma medication adherence. Other patient factors that may play an important role include patient's illness and health beliefs, lifestyle or other modifiable health behavioral risk factors, degree of self-efficacy regarding taking care of one's vision, communication styles, cognitive factors, social support, trust in health providers, literacy, and level of involvement in medical decision-making among persons of African descent.[27–30]

Not until recently, has there been a recognition of the need to understand these factors in relation to the multifaceted nature of glaucoma medication adherence,[25, 31] particularly the behavioral and lifestyle factors.[13, 32–34] Understanding these types of factors, many of which are modifiable risk factors, may expand our knowledge related to long-term management of glaucoma medication adherence.[35] Health disparities and medication adherence among

persons living with chronic health conditions is a significant and growing issue.[36–39] The racial disparity observed in this as well as other studies indicates that clinicians should pay special attention to patients of African descent when prescribing glaucoma medications. Future studies should examine the unique reasons related to adherence in all glaucoma patients including those of African descent. Focus group methodology or structured interviews might represent ways in which more qualitative information driving lowered medication adherence might be more fully understood.[40] This type of information may also serve to inform directions for intervention efforts targeting problems related to non-adherence.[41]

Currently there is a paucity of research examining intervention strategies to enhance glaucoma medication adherence. While doctor-patient communication strategies and increased patient education have been emphasized and shown to be effective,[19, 42–44] examination of health promotion-based efforts are also other strategies worthy of investigation in this area given the link between medication adherence and health behaviors. Encouragingly, health promotion-based efforts tailored to a patient's unique barriers and health behaviors have shown promising results toward improving health outcomes and long-term adherence among persons with underserved populations living with chronic health conditions.[45, 46] These types of interventions help patients learn alternative strategies for overcoming obstacles associated with poor medication adherence unique to individual behaviors, beliefs and attitudes, and environmental resources. Moreover, such approaches also help build motivation, self-efficacy, and more accurate health beliefs in addition to knowledge regarding chronic health conditions and the impact of medications on outcomes.[47] These approaches are often particularly successful when accompanied by "booster sessions" or on-going support and training versus one-time training educational sessions. Education alone does not often lead to changes in behavior, attitudes, and cognition.[48] However, before such intervention efforts can be designed and tested in terms of testing which components might best address the medication adherence (e.g., problem-solving training, theory planned behavior, behavioral activation), a more comprehensive understanding of the complexity of the reasons underlying lower medication adherence among persons of African descent is needed.

Recommendations for Clinical Practice

Traditional glaucoma services have not been approached eye care services from a mulitidisciplinary approach. Improving adherence to glaucoma therapy might be enhanced by integrating mental health providers as part of routine eye care services given their training in health promotion-based efforts, biopsychosocial approach to helping patients modify unhealthy lifestyle choices, background in behavioral activation and modification have been empirically shown to enhance adherence in other diseases (e.g., diabetes, asthma). Given the busy nature of glaucoma clinics, the fact that patients may not want to admit to their direct provider problems with medication management, and given other chronic health conditions that patients often present with,[49] this type of approach might prove beneficial in such settings. These types efforts have already been adapted into other disciplines in which long-term management of a chronic health condition is inevitable and is part of standard care (e.g., cardiovascular disease, hypertension, diabetes, cancer, HIV/AIDs, traumatic brain injury, spinal cord injury).[39] Integrating this type of an approach may help in treating the patient as a whole by allowing a focus on both eye disease and quality of life. This may also permit a more comprehensive risk assessment for problems with adherence which may include factors not typically assessed in traditional eye care services (i.e., motivation, personality, sense of well-being, social support, psychological functioning, financial support, management of other chronic health conditions, and the role of the family on adherence). As adherence is a highly complex behavioral aspect of health care, treatment

plans which are individually tailored to address patients' unique risk factors may better enhance more adaptive adherence behaviors and problem-solving strategies for overcoming barriers related to adherence.

Limitations

Our results underscore the need to consider factors such as race and other socioeconomic characteristics associated with lowered medication adherence. However, limitations must be acknowledged. The subjects were aware that their behavior was being monitored which may have led to an artificial inflation of their natural behaviors related to adherence (i.e., Hawthorne effect). As previously mentioned, another factor which may have also artificially impacted typical behavior patterns is related to the fact that medications were being provided at no cost. On a similar note, it should also be highlighted that these findings associated with lowered medication adherence were observed despite cost not being a factor. Thus, these adherence rates may have in fact been much lower in terms of actual adherence had cost been part of the equation. However, given the purpose of the study, this approach was necessary to eliminate cost in order to study adherence. Another limitation is related to the fact that depressing the lever of the Travatan Dosing Aid does not confirm that the drops were correctly placed into the eye. A final limitation is that the dosing aid only holds Travapost. Therefore, the study was limited to understanding patient behavior surrounding a specific glaucoma medication.

In summary, medication adherence is a challenging problem for eye care providers who provide services to patients with glaucoma. The findings from this study highlight the importance of understanding risk factors associated with lowered levels of glaucoma medication adherence such as race. As persons of African descent are at a much greater risk for developing glaucoma, the findings from this study indicate the need for further research exploring the unique barriers and facilitators associated with lowered adherence among this population of patients. Our group is currently examining this issue with focus groups and semi-structured interviews in follow-up to these results. This type of information will help to explain the reasons driving race as a significant predictor for lower adherence.

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Table 1

Descriptive Characteristics of the Sample at Baseline.

Characteristic	Total Sample (*N* = 116)	
Demographic and Socioeconomic Characteristics		
Age, *M(SD)*	64	(13.73)
Gender, *n (%)*		
Women	66	(56.9%)
Men	50	(43.1%)
Race, *n (%)*		
European descent	65	(56%)
African descent	48	(41.4%)
Asian descent	2	(1.7%)
Other descent	1	(.9%)
Highest level of education, *n (%)*		
Primary school (grades 1–6)	1	(.9%)
Secondary school (grades 7–12 without graduation or GED)	13	(11.2%)
High school graduate or GED recipient	25	(21.6%)
Some college (1–4 years post-high school)	29	(25%)
College grad (Bachelors degree)	21	(18.1%)
Some post-graduate	6	(5.2%)
Post-graduate degree (Masters degree or higher)	21	(18.1%)
Household income level, *n (%)*		
Less than or equal to 100% of federal poverty level (FPL)	9	(7.8%)
Between 101–150% of FPL	16	(13.8%)
Between 151–200% of FPL	9	(7.8%)
Greater than 201% of FPL	68	(58.6%)
Do not know or Refused to Answer	14	(12.1%)
Number of persons in household, *M(SD)*	2	(1.19)
Medical Characteristics		
Total # of co-morbid chronic health conditions, *M(SD)*	1.34	(1.24)
Type of chronic health condition, *n (%)*		
Hypertension		
No	66	(56.9%)
Yes	50	(43.1%)
Asthma		
No	105	(90.5%)
Yes	11	(9.5%)
Arthritis		
No	88	(75.9%)
Yes	28	(24.1%)
Cancer		
No	101	(87.1%)

Characteristic	Total Sample (*N* = 116)	
Yes	15	(12.9%)
Emphysema		
No	115	(99.1%)
Yes	1	(.9%)
Thyroid		
No	104	(89.7%)
Yes	12	(10.3%)
Congestive heart failure		
No	113	(97.4%)
Yes	3	(2.6%)
Coronary artery disease		
No	104	(89.7%)
Yes	12	(10.3%)
Seizures		
No	113	(97.4%)
Yes	3	(2.6%)
Diabetes		
No	95	(81.9%)
Yes	21	(18.1%)
Total # of non-vision related/oral medications, *M(SD)*	3.60	(3.16)
Ocular Characteristics		
Visual field mean deviation OD, *M(SD)*	−5.00	(7.46)
Visual field mean deviation OS, *M(SD)*	−5.00	(7.35)
IOP OD, *M(SD)*	17.65	(6.12)
IOP OS, *M(SD)*	17.77	(5.57)
Total # of glaucoma eye drops taken per day, *M(SD)*	3.48	(2.18)
Total # of other glaucoma eye medications, *M(SD)*	.74	(.80)
Total # of other eye diseases (e.g., AMD, cataracts, diabetic retinopathy), *M(SD)*	.50	(.55)
AMD, *n (%)*		
No	113	(97.4%)
Yes	2	(1.7%)
Missing data	1	(.9%)
Cataracts, *n (%)*		
No	60	(51.7%)
Yes	55	(47.4%)
Missing data	1	(.9%)
Diabetic Retinopathy, *n (%)*		
No	114	(98.3%)
Yes	1	(.9%)
Missing data	1	(.9%)

Table 2

Univariate and Multivariate Baseline Determinants of Objective Medication Adherence for Glaucoma at 3-Month Follow-Up Using Three Different Objective Adherence Definitions.

Criterion Variable	*Predictors*	*r*	*p*	β	S.E.β	R^2/ R^2inc	*p*
***Definition 1*: Full Objective Adherence**	**Model 1**					**.11**	**<.001**
	Race	**.31**	**.001**	**.087**	**.024**		**<.001**
	(Constant)			.188	.125		---
	Age	.20	.03				
	Total Number of Other Eye Diseases	.22	.02				
***Definition 2*: Partial Objective Adherence**	**Model 1**					**.18**	**<.001**
(proportion of the number of days any eye drops taken within *3 hours* of prescribed dosing time)	**Race**	**.33**	**<.001**	**.109**	**.024**		**<.001**
	(Constant)			.185	.124		---
	Age	.20	.04				
	Income	.24	.02				
	Level of Education	.23	.02				
	Total Number of Other Eye Diseases	.24	.009				
***Definition 3*: Partial Objective Adherence**	**Model 1**					**.15**	**<.001**
(proportion of the number of days any eye drops taken within *6 hours* of prescribed dosing time)	**Race**	**.27**	**.003**	**.089**	**.022**		
	(Constant)	.344	.114				
	Model 2					**.04**	**.04**
	Race	**.27**	**.003**	**.070**	**.023**		**.004**
	Income	**.32**	**.001**	**.047**	**.022**		**.04**
	(Constant)			.288	.115		---
	Level of Education	.31	.001				
	Total Number of Other Eye Disease	.21	.03				

Note. Significant multivariate predictors for each model of adherence are presented in bold.
Race = Race of the participant (0 = African descent; 1 = European descent)
Income = Household income (1= less than or equal to 100% of federal poverty level (FPL); 2 = between 101–150% of FPL; 3 = between 151–200% of FPL; 4 = greater than 201% of FPL)