Aspirin Use among Diabetic Patients: Estimates from Behavioral Risk Factor Surveillance System in 1999

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Objective: Aspirin is known to be a good agent for the primary prevention as well as the secondary prevention of cardiovascular diseases. The objective of the study was to estimate the prevalence of aspirin use and to find factors that are related with aspirin use among diabetic patients in the U.S.

Methods: The Behavioral Risk Factor Surveillance System (BRFSS) of 1999 was used for the data. Only 17 states had the information on diabetes and cardiovascular diseases and all the observations of these 17 states were included in the analysis. Anderson's health-behavior model was slightly modified and used as the analytic framework. The problem from using aspirin was added in the Anderson's model along with predisposing, enabling, and need factors. Logistic regression with the weight option was used to estimate the factors that may be associated with aspirin use.

Results: The percentage of aspirin use among diabetic patients was 14.75%, while 14.67% of all the other observations used aspirin. Diabetic patients who had the following characteristics used aspirin less; aged 71 or older, male, college education, high cholesterol, smoking everyday, drinkers, obese people, having had myocardial infarction or coronary heart disease, low income (under $14,999), uninsured.

Conclusion: Despite the fact that most of diabetic patients have at least one risk factor of cardiovascular disease, the prevalence of aspirin use was very low. To enhance aspirin use among diabetic patients, there are needs for the physician education for diabetic patients in general, and the targeted education for those diabetic patients whose aspirin use was particularly low.

Key word: diabetes, aspirin use, prevention of cardiovascular diseases

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Ⅰ. Introduction

Diabetes is one of the most prevalent chronic diseases in the U.S. Among those who are aged 65 and older, 18.4% have diabetes (CDC, 2001). 8.2% of people aged 20 and older suffer from this disease (CDC, 2001). It is not so surprising that the National Center for Health Statistics reported diabetes as the seventh leading cause of death listed on the U.S. death certificated in 1996. The American Diabetes Association has estimated the costs of diabetes as about $98 billion in 1997.

Diabetic patients normally have several complications. Some of the examples are heart disease, stroke, high blood pressure, kidney disease, amputations, and blindness. Diabetic patients are twice or four times more likely to die from heart disease or stroke (CDC, 2001). Therefore, if they could prevent cardiovascular diseases like heart disease or stroke, their chances to die might be lessened.

Aspirin is known to be a good agent for the primary prevention as well as the secondary prevention of cardiovascular diseases. The Hypertension Optimal Treatment (HOT) Trial and the U.S. Physicians' Health Study are some of the randomized control trials that tested the secondary prevention role and the primary prevention role of aspirin respectively.

Given that many diabetic patients are at high risk of cardiovascular diseases and they should be prescribed aspirin for the prevention of those diseases, it will be interesting to examine the prevalence of aspirin use among diabetic patients. This study aims at finding those factors that prevent diabetic patients from taking aspirin for preventing

cardiovascular diseases. The results will provide policy implications on the enhancement of aspirin use among these high-risk groups.

Ⅱ. Literature Review

Diabetic patients are at higher risk for cardiovascular diseases. Platelets from diabetic patients are often hypersensitive in vitro to platelet aggregating agents (ADA, 2001). A major mechanism is increased production of thromboxane, a potent vasoconstrictor and platelet aggregant (ADA, 2001). Researchers found that thromboxane is excessively released in type 2 diabetic patients with cardiovascular disease (ADA, 2001). Aspirin is known to block thromboxane synthesis.

In the Early Treatment Diabetic Retinopathy Study (ETDRS), the effects of aspirin on mortality, the occurrence of cardiovascular events, and the incidence of kidney disease were examined (Anonymous, 1992). Patients with diabetes mellitus were randomly assigned to aspirin (two 325mg tablets one a day) or placebo. In the results, the estimate of relative risk for total mortality for aspirin-treated patients compared with placebo-treated patients was 0.91 (99% confidence interval, 0.75 to 1.11) and the estimate of relative risk of myocardial infarction was 0.83 (99% confidence interval, 0.66 to 1.04).

A meta-analysis on the primary prevention effect of aspirin shows similar results. Hart et al (2000) found from their meta-analysis that aspirin did not have significant effects on stoke (95% confidence interval, 0.95-1.24), but it had significant effects on myocardial infarction (95% confidence interval, 0.68-0.82). Aspirin's effect on reducing stroke is not

consistent across the studies of different settings. For example, Iso et al (1999) found similar results as the study done by Hart et al (2000), but Kalra et al (2000) found that aspirin use might be associated with a small but significant reduction in stroke mortality.

Based on favorable results on the prevention effect of aspirin, the American Diabetes Association recommends that diabetic men and women with a history of myocardial infarction, vascular bypass procedure, and stroke use aspirin as a secondary prevention strategy. The ADA also recommends that high-risk diabetic patients use aspirin as a primary prevention strategy. The high-risk group is defined as follows: a family history of coronary heart disease, cigarette smoking, hypertension, obesity (>120% desirable weight) or BMI>27.3 in women, >27.8 in men, albuminuria, hyperlipidemia, age>30 years (ADA, 2000). Meanwhile, those people who have aspirin allergy, bleeding tendency, anticoagulant therapy, gastrointestinal bleeding are not candidates for aspirin therapy (ADA, 2000).

Despite the ADA's recommendations, not all the diabetic patients who are at high risk of having cardiovascular diseases (CVD) take aspirins. Rolka et al(2001) report that only 37% of those with CVD and 13% of those with risk factors use aspirin regularly. They also found that only 20% took aspirin regularly during 1988-1994. Considering the fact that nearly all the diabetic patients in the U.S. have at least one risk factor for CVD, major efforts are needed to increase aspirin use.

The findings above lead to the following two research questions: (1) How many percentages of diabetic patients are using aspirin to prevent cardiovascular diseases? (2) What are the factors that are associated with the aspirin use among diabetic patients?

Ⅲ. Model

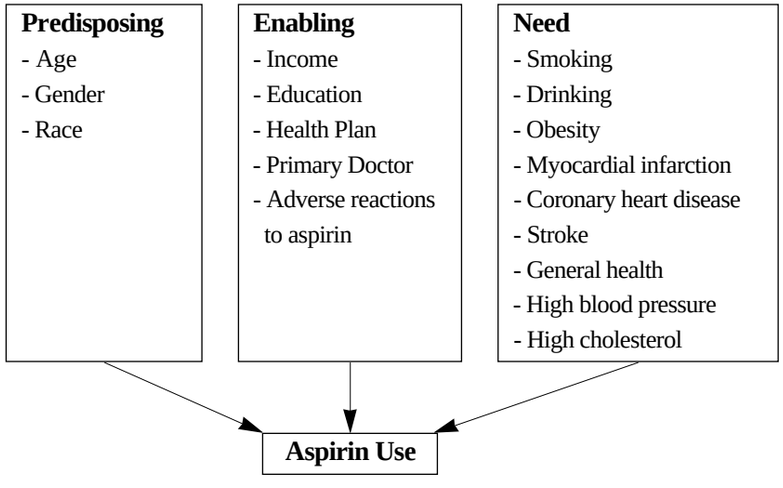
The behavioral model devised by Anderson (2000) is used to examine the extent to which predisposing, enabling, and need factors explain the aspirin use. Anderson model is widely used for the studies about health services utilization. Specific variables for each factor vary depending on the objectives of different studies though. For this study, variables were chosen such that they predict aspirin use well. The only difference between Anderson model and the proposed model here is that the drug characteristic factor is included as an enabling factor. Even though people perceive the importance of aspirin and they are able to purchase aspirin, they may not use it because of adverse reactions from taking aspirin. Therefore, the characteristics of a drug are an important factor when it comes to the utilization of a drug.

Figure 1 describes the conceptual model including the variables for each factor. Age, gender, and race were included in the predisposing factor. The variables for the need factor were chosen based on the risk factors designated by the American Diabetes Association. The risk factors for cardiovascular diseases in general include being male, heredity, advancing age, smoking, drinking, obesity, high blood pressure, and high cholesterol. Diabetic patients who have had any kind of cardiovascular diseases in the past are also recommended to take aspirin to prevent reoccurring cardiovascular diseases. Such cardiovascular diseases include myocardial infarction, coronary hear disease, and stroke.

Lastly, the enabling factor included income, education, having any

health plan, and having a primary care physician. All the included factors were hypothesized to be positively correlated with aspirin use among diabetic patients.

Figure 1. Conceptual Model of Aspirin Use among Diabetic Patients



Ⅳ. Data and Methods

The study was designed cross-sectional. Therefore, the relationship between the explanatory variables and aspirin use represents an association and not a causal relationship.

The Behavioral Risk Factor Surveillance System (BRFSS) was used for the data. The BRFSS is a collaborative work of the Centers for Disease Control and Prevention (CDC), and U.S. states and territories. The BRFSS is designed to measure behavioral risk factors in the adult population aged 18 years and older through telephone-based methods.

The questionnaire has three components: core, optional CDC modules, and state-added questions. Not all the states provide all the components. Diabetes is of the core components and cardiovascular disease is one of optional CDC modules. In 1999, there were 17 states that provided both diabetes and cardiovascular disease modules[1]. The names of 17 states are listed in Table 1.

Table 1. The 17 states that provide both diabetes and cardiovascular disease modules

Alabama	Arizona	District of Columbia	Georgia	Iowa
Kentucky	Louisiana	Maine	Montana	New Mexico
New York	North Carolina	North Dakota	Ohio	Oklahoma
Virginia	Wisconsin			

Source: BRFSS, 1999 (CDC).

Since the data is collected via telephone, lower socioeconomic groups may be underrepresented in the data. However, this bias can be partially reduced by using post-stratification weights (CDC, 1999). Post-stratification weights are included in the formula for calculating final weights and therefore the bias from not having telephones could be adjusted partially.

The final weights that were applied in the analysis are calculated in the following way.

Final weight= GEOWT*DENWT*1/NPH*NAD*CSA*POSTSTRAT

GEOWT weights for the unequal probability of selection by area code/prefix combinations intended to cover specified geographic regions.

1) Diabetes module in New York is one of its optional modules.

DENWT weights for the unequal probability of selection by presumed household density of hundred blocks. NPH stands for the number of residential telephone numbers in the respondent's household. NAD is the number of adults in the respondent's household. CSA is the ratio of the expected cluster size to the actual cluster size. POSTSTRAT adjusts for non-coverage and non-response.

To examine if the 17 states that were included in the sample were different from the entire population, the two groups were compared in terms of several demographic characteristics. T-test and chi-square test were used to find differences between diabetic patients and people without diabetes.

To estimate aspirin use among diabetic patients, multivariate logistic regression was used. The dependent variable is "1", if a person answered yes to at least one of the following two questions: (1) Why do you take aspirin? To reduce a chance of a heart attack (2) Why do you take aspirin? To reduce a chance of a stroke. Due to its binary values, logistic regression was used.

Some of the explanatory variables were recoded. For example, age and obesity were recoded as categorical variables from continuous variables. One of the objectives of the study is to find the target group for special education on aspirin use and I was interested in which age group might be the needy group. Obesity was defined as a risk of cardiovascular disease by ADA and Body Mass Index was transformed to make the variable of obesity according to the definition of ADA, which is >27.3 in women and >27.8 in men. Income and education were recoded with reduced number of categories.

V. Results

The 17 states in the sample were not very different from the entire population (Table 2). Even though p-values were less than 0.001 for the comparisons of gender, education, income, and general health, these results might occur because of the big sample sizes.

Table 2. Comparisons of Demographic Characteristics of the Sample and the Entire Population

		Sample (N=60,540,000)	Population (N=205,700,000)
		Mean (SD) or % Weighted	Mean (SD) or % Weighted
Age		45.4 (17.5)	45.3 (17.5)
Gender***	male	47.59	48.20
	Female	52.41	51.80
Education***	1	0.27	0.26
	2	4.38	5.49
	3	9.31	8.12
	4	34.46	31.35
	5	25.58	27.01
	6	25.66	27.36
	9	0.34	0.40
Income***	1	11.27	13.09
	2	19.71	19.22
	3	38.20	34.59
	4	30.82	33.10

<Table 2> 계속

General***	1	22.57	23.97
Health	2	34.91	33.36
	3	28.45	28.38
	4	9.89	10.80
	5	4.19	3.50

Note: Education 1=Never attended school or only kindergarten, 2=Grades 1 to 8, 3=Grades 9 to 11 (some high-school), 4=Grades 12 or high-school graduate, 5=1~3 years college, 6=College 4 years or more, 9=Non-response; Income 1= less than $14,999, 2=$15,000 to $24,999, 3=$25,000 to $49,999, 4=$50,000 and more; General Health 1=Excellent, 2=Very good, 3=Good, 4=Fair, 5=Poor

*** p-value is <0.001

Source: BRFSS, 1999 (CDC)

Some of the characteristics of diabetic patients are summarized in Table 3. Compared to non-diabetic people, diabetic patients tended to be older, non-white, male, and less educated. Interestingly, the blood pressure of diabetic patients was lower than the one of non-diabetic patients. It is counter-intuitive because high blood pressure is one of the most common comorbid conditions of diabetes. As expected, diabetic patients had higher cholesterol level. This fact may be related to higher prevalence of myocardial infarction, coronary heart disease, and stroke among diabetic patients. About one third of diabetic patients were obese, while about one fifth of non-diabetic patients were obese. Diabetic patients were more likely to be low income, but they were slightly more likely to have any health plans and a primary care physician.

The prevalence of aspirin use among diabetic patients was not found to be very different from the entire sample. 14.75% of diabetic patients used aspirin to prevent MI or stroke, while 14.67% of the non-diabetic sample used aspirin.

Logistic regression results are shown in Table 4. Among predisposing

Table 3. Chi-square Test Results of Comparing Characteristics of Diabetic Patients and Non-Diabetic People

		Diabetes (N=3,577,677)	No Diabetes (N=56,375,021)
		% Weighted	% Weighted
Age***	under 30	3.92	25.02
	31~40	6.99	22.74
	41~50	21.47	20.81
	51~60	23.70	13.88
	61~70	24.56	9.24
	71~80	15.83	6.46
	81 +	9.81	1.84
Race ***	White	33.62	39.42
	Non-white	66.38	60.58
Gender***	male	50.02	48.62
	Female	49.98	51.38
Education***			
	- Grade 8	8.73	3.34
	Grade 9~Grade 12	46.41	42.03
	College +	44.86	54.63
General Health***			
	Excellent	4.96	23.75
	Very Good	15.11	36.21
	Good	34.48	27.90
	Fair	27.05	8.82
	Poor	18.40	3.32
High Blood Pressure***		43.48	77.03
High Cholesterol***		42.95	20.85
Smoking***			
	Everyday	13.67	20.46
	Some days	3.14	4.88
	Not at all	36.02	23.30
Drinking***		29.58	52.80
Obese***		33.92	18.35

<Table 3> 계속

Myocardiac Infarction***		14.27	3.52
Coronary Heart Disease***		13.92	3.44
Stroke***		7.81	1.80
Income ***	- $14,999	22.34	10.33
	$15,000-$24,999	23.75	19.31
	$25,000-$49,999	34.33	38.56
	$50,000 +	19.58	31.80
Having any Health Plans***		89.46	87.02
Having a Primary Care Doctor***		9.15	7.39
Aspirin problem***			
	Non-stomach related	9.56	2.94
	Stomach related	6.64	4.32
	No Problem	42.90	42.89
Aspirin***	Yes	14.75	14.68
	No	85.25	85.32

Note: Obese - When BMI (Body Mass Index) >27.3 for women and BMI>27.8 for male.
*** p-value is <0.001

factors, only race was related to aspirin use. Whites used less aspirin than non-whites. This is counter-intuitive, since non-whites tend to have lower socioeconomic status than whites and socioeconomic status is an important component of enabling factors for health care utilizations. There were no differences of aspirin use in terms of age and gender.

Among the enabling factors, income was the only significant predictor of aspirin use. Compared to people whose income was over $50,000, people whose income ranged between $15,000 and $49,999 were more likely to use aspirin. Adverse reactions from using aspirin, education, having health plans, and having a primary physician did not make any difference in aspirin use.

Among need factors, blood pressure and smoking were significant

Table 4. Logistic Regression Analysis of Aspirin Use among Diabetic Patients, 17 States, 1999 (N=3,577,677)

		Odds Ratio (95% CI)
	Non-Stomach-related Prob	0.914 (0.763 to 1.095)
	Stomach-related Prob	0.992 (0.852 to 1.154)
	No Prob	1
Race White		0.924 (0.866 to 0.987)*
Non-white		1
Age	- 30	1.088 (0.850 to 1.394)
	31~40	1.079 (0.842 to 1.382)
	41~50	1.024 (0.800 to 1.311)
	51~60	1.165 (0.909 to 1.493)
	61~70	1.047 (0.814 to 1.346)
	71~80	0.957 (0.738 to 1.242)
	81 +	1
Gender	Male	0.988 (0.921 to 1.061)
	Female	1
Education	- Grade 8	1.012 (0.846 to 1.211)
	Grade 9~Grade 12	1.043 (0.974 to 1.116)
	College +	1
General	Excellent	1
Health	Very Good	1.092 (1.005 to 1.187)*
	Good	0.978 (0.893 to 1.071)
	Fair	1.014 (0.892 to 1.151)
	Poor	1.141 (0.957 to 1.361)
Non-High Blood Pressure		0.913 (0.845 to 0.986)*
High Cholesterol		0.967 (0.884 to 1.036)
Smoking	Everyday	0.905 (0.833 to 0.981)*
	Some days	1.042 (0.902 to 1.204)
	Not at all	1
Drinking		0.957 (0.897 to 1.022)
Obese		0.971 (0.890 to 1.067)
Myocardiac Infarction		0.904 (0.751 to 1.087)
Coronary Heart Disease		0.850 (0.705 to 1.025)

<Table 4> 계속

Stroke		1.068 (0.860 to 1.327)
Income	- $14,999	0.891 (0.784 to 1.013)
	$15,000-$24,999	1.147 (1.038 to 1.267)**
	$25,000-$49,999	1.098 (1.015 to 1.187)*
	$50,000 +	1
Having any Health Plan		1.042 (0.944 to 1.149)
Having a Primary Care Doctor		1.015 (0.904 to 1.139)

Note: Obese - When BMI (Body Mass Index) >27.3 for women and BMI>27.8 for male.
* p-value is <0.05, ** p-value is <0.01

predictors of aspirin use. Those whose blood pressure was higher were more likely to use aspirin. People who smoked everyday used less aspirin than non-smokers. In addition, diabetic patients who reported their general health was “excellent” were using less aspirin than people who reported their health was “very good.”

Several need factors were not related to taking aspirin as a primary prevention of cardiovascular diseases. Such need factors include past experiences of myocardial infarction, coronary heart diseases, or strokes, obesity, and drinking. It can be a problem that the diabetic patients with these risk factors were not different from those without these risk factors in taking aspirin, because these factors are risk factors of cardiovascular diseases.

VI. Discussion

Rolka et al. reported that 13% of those with risk factors of cardiovascular diseases used aspirin (2001). A similar result was found in this study, which is 14.75%. The difference between the two results may be found from the data sources, the definitions of aspirin use, and the definitions of denominators. Rolka et al. used the Third National Health and Nutrition Examination Survey using a question asking the regular use of aspirin among diabetic patients who had one or more risk factors of cardiovascular diseases. On the other hand, I used the BRFSS using two questions asking aspirin use for preventing myocardial infarction or stroke among the entire diabetic patients regardless of the existence of risk factors.

The factors that were associated with aspirin use were also different from those factors that Rolka et al. had found in their study. Rolka et al found that cardiovascular diseases, white race, older age, and male were strongly associated with regular aspirin use. On the other hand, all these factors were not associated with aspirin use in this study except race. Even for the race variable, the direction of the association was opposite, in other words, non-white people were more likely to take aspirin. These discrepancies need to be clarified in the future research.

Diabetic patients who have the following behavioral risk factors were found to need interventions: smoking and obesity. Smoking and drinking are related to high cholesterol and high blood pressure which are risk factors of cardiovascular diseases. The study results showed that everyday smokers were less likely to use aspirin than non-smokers and there is a need to educate these everyday smokers to use aspirin regularly. Obese people are also a high-risk group but their use of aspirin was not more prevalent than non-obese people. Therefore, there is also a need to educate obese people to enhance their aspirin use.

People whose income was over $50,000 (reference group) were less

likely to use aspirin compared to people whose income range was between $15,000 and $49,999. People whose income level was below $15,000 used aspirin less compared to the reference group but the relationship was not significant. The lower level of aspirin use of the reference group may be explained by higher percentage of white people in this group, since being a white was associated with less aspirin use. However, further investigations are needed to explain the income effect on aspirin use.

It is interesting to find that adverse reactions from taking aspirin was not associated with aspirin use. This result means that even though diabetic patients experience problems from taking aspirin, they take aspirin as much as those who do not have any adverse reaction problems. One possible explanation of this result may be that those who used aspirin were more cautious on cardiovascular diseases that non-users maybe because the former had more risk factors such as myocardial infarction, heart attack, or other coronary heart diseases. Future research needs to look at the detailed features of aspirin users and non-users especially their risk factors.

Even though all the hypothesized explanatory variables were not significantly related with aspirin use, Anderson model was found to be a good model to predict aspirin use in general. All three hypotheses were partially supported.

There are several limitations to mention. First, this is a cross-sectional study, therefore only associations can be inferred from the results. Second, some of the people who used aspirin regularly might not be included in the aspirin use group. This kind of misallocation might occur because I used two questions asking aspirin use only for preventing myocardial infarction and stroke. There may exist people who take

aspirin regularly because of arthritis or pain and these people were allocated as non-aspirin users. Third, even though people reported that they used aspirin, but it was impossible to know how regularly they used it. In the BRFSS, there is no variable asking that question.

Ⅶ. Conclusion

Despite the fact that almost all diabetic patients have one or more risk factors of cardiovascular diseases, only 14.75% of them used aspirin in 1999. Being a white, having high blood pressure, smoking everyday, and income over $50,000 were related to less aspirin use. Special education targeted to these groups is needed. Future research needs to investigate detailed characteristics of aspirin users and non-users in terms of their risk factors so that why the above groups use less aspirin can be revealed.

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Summary

1999년 Behavioral Risk Factor Surveillance System으로 측정한 당뇨병 환자들의 아스피린 사용

姜 銀 貞

아스피린은 심혈관계 질환의 위험이 있는 당뇨병환자들에게 심혈관계 질환의 일차예방 및 이차예방을 위해 필요하다. 본 연구는 미국의 당뇨병 환자들 가운데서 아스피린의 사용자수를 파악하고 아스피린 사용과 관련된 요인을 발견하는 것이 목적이다.

연구방법으로는1999년 Behavioral Risk Factor Surveillance System (BRFSS) 이 연구자료로 사용되었다. 17개 주만이 당뇨병과 심혈관계 질환에 관한 자료를 가지고 있어 이들 17개 주만 표본에 포함되었고, 17개 주의 모든 관찰자가 분석에 사용되었다. 건강행태와 관한 앤더슨 모델이 수정되어 분석모형으로 사용되었으며, 가중치를 사용한 로지스틱 분석으로 아스피린의 사용과 관련되어 있는 요인들을 분석하였다.

연구결과 당뇨병 환자들 가운데 14.75%만이 심혈관계 질환의 예방목적으로 아스피린을 사용한 반면, 당뇨병을 갖고 있지 않은 사람들의 14.67%가 심혈관계 질환의 예방목적으로 아스피린을 사용하여 당뇨병 환자들과 차이가 없었다. 당뇨병 환자들 가운데 71세 이상 노인, 남자, 대학졸업자, 콜레스테롤이 높은 자, 매일 흡연자, 음주자, 비만자, 심근경색이나 관상동맥질환을 앓은 적이 있는 자, $14,999 이하의 저소득계층, 무보험자와 같은 특성을 가진 사람들이 심혈관계 질환의 예방을 위한 아스피린 사용이 적었다.

결론적으로 대부분의 당뇨병 환자는 심혈관계 질환을 앓을 위험요인을 가지고 있다. 그럼에도 불구하고 당뇨병 환자들의 아스피린 사용률은 매우 낮았다. 당뇨병 환자들의 심혈관 질환 예방 목적의 아스피린 사용을 촉진하기 위해서는 의사 및 아스피린 사용률이 상대적으로 낮은 당뇨병 환자들을 대상으로 한 교육이 매우 필요하다.