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Willingness to Pay Analysis of Elderly Diabetics for Confronting Diabetic Retinopathy

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*S u m m a r y. **INTRODUCTION**: Diabetic retinopathy (DR) is a frequent complication of diabetes mellitus (DM). The appearance of DR depends mainly on the duration of the diabetic disease and thus a diabetic who suffers from DM for 20 years, has a 90% probability to develop DR. Aim: This study was conducted to measure how diabetic patients value risk reduction of DR, and estimate the maximum amount of money and percentage of monthly income these patients would pay for reduction of DR risk. **METHODS**: All patients gave written consent. 419 DM patients, aged ≥60 years were evaluated using «willingness to pay» (WTP) for cost-benefit analysis. After receiving background information, patients were asked how much money they would pay per month for a drug that would reduce their DR risk by 30%, 60% or 90%. Patients also indicated the importance of risk reduction on a 10-degree scale (0 = not important, 10 = extremely important). Data collected included demographic information, diabetes duration and treatment, presence of DR or symptoms, and whether patients knew someone with DM. Data normality was assessed with the Kolmogorov-Smirnov test. Differences between more groups (by education level, diabetes duration or monthly income) were evaluated with the Kruskal-Wallis test. The Mann-Whitney test was used to compare groups (men vs. women, knowing vs. not knowing someone with DM, having vs. not having DR) and for post-hoc comparisons. Factors influencing "WTP" were identified with logistic regression, using "WTP" > a certain income percentage as binary dependent variable. P values <0.05 were considered significant. **RESULTS**: Patients having DR were willing to pay more for risk reduction (p=0.002, p=0.007 and p=0.000 for reduction by 30, 60 or 90% respectively). Patients having DM for >10 years were willing to pay more (p=0.013, p=0.012 and p=0.002 for risk reduction by 30, 60 or 90% respectively). Diabetics using insulin were willing to pay more for*

risk reduction to 0% (p=0.002). Diabetics knowing other diabetics were also willing to pay more (p=0.032, p=0.017 and p=0.001 for risk reduction by 30, 60 or 90% respectively). Higher education and income were associated with willingness to pay more for risk reduction. ***CONCLUSIONS****: DR risk reduction is important to DM patients, especially those having DM for >10 years, suffering from DR or knowing someone with DM. Education and monthly income significantly influence the perceived value of DR risk reduction.*

INTRODUCTION

Diabetes mellitus is a metabolic syndrome that is caused due to absolute or relative insufficiency of insulin excretion or even decreased sensitivity of tissues in the action of this hormone (1). It is often accompanied by the appearance of complications. Diabetic retinopathy is a frequent complication of diabetes mellitus. Eighty five percent of diabetics develop diabetic retinopathy (1). Ninety percent of insulin-dependent patients who suffer from the disease for at least 20 years develop the complication (2). The American Diabetic Association (ADA) reports that almost all patients with type I diabetes present this complication 20 years after the appearance of the disease (3). Furthermore, the appearance of diabetic retinopathy depends mainly on the duration of the disease and thus a diabetic who suffers from diabetes mellitus for a period of 20 years, has a 90% probability to develop diabetic retinopathy as well (4).

The probability of blindness is 20 times greater in diabetic patients. In the USA, diabetes mellitus is the leading cause of new cases of blindness among adults 20 to 74 years of age (5), causing the appearance of 8000 new cases annually (6). Nowadays diabetes is responsible for the 8% of cases of blindness and it is the first cause that leads adults aged 20 to 74 years to blindness (3). That means that every year approximately 12000-24000 individuals lose their vision due to diabetes mellitus (3). In 2005–2008, 4.2 million (28.5%) people with diabetes aged 40 years or older had diabetic retinopathy, and of these, 655000 (4.4% of those with diabetes) had advanced diabetic retinopathy that could lead to severe vision loss (5). Every year in Canada there are 400 new cases of blindness that are attributed to diabetes (7).

Confronting the cost of the complication, in combination with the regularly ascendant repercussion of the disease, as well as the increasing number of diabetics, renders imperative the need for the conduct of analyses that evaluate the cost of confrontation of this complication. Subject of this research is the measurement of the value that elderly diabetic patients attribute to the risk reduction of the appearance of diabetic retinopathy, using *the willingness-to-pay* method.

METHODOLOGY

Willingness-to-pay method was selected, since the expected benefit (risk reduction of appearance of diabetic retinopathy) could be determined and patients knew precisely what they were paying for (8). According to the method, in each result or outcome or health intervention there is a price that can be attributed, which is equal to the amount that someone intends to pay in order to avoid a certain undesirable health condition and maintain or improve his/her level of health (8,9). Diabetics were submitted to open-ended questions, with regard to their willingness to pay for each percentage of risk reduction. Open-ended questions were selected in order to achieve an unbiased estimation of willingness to pay, since the person who is questioned does not have a prompter or is not being urged (10,11). In this way, bias is avoided in the beginning, as it happens with closed-ended questions (bidding games, payment cards, checklist, take-it-or-leave-it), where the answers are influenced by the first amount of money that is presented (10). Nevertheless, during the interviews there were a few cases of diabetics, who were negative in having their personal data and their monthly family income recorded.

The value that patients attribute to the reduction of the risk of diabetic retinopathy was measured using an approach of contingent valuation, which measures the willingness to pay for a given health benefit (12,13). This method is the basis for the attribution of value in the results of contingent valuation in health studies. In these studies, inquiring methods are used in order to present hypothetical scripts with regard to the program or the problem that is evaluated (10). The participants are requested to think of the possibility of existence of real market conditions, for a program or health benefit and specify the highest amount of money they are willing to pay for such a program or benefit (12,13).

This research was designed for the measurement of the highest amount and of the highest percentage of monthly family income, that elderly diabetics would be willing to give in order buy a

drug that reduces danger of appearance of diabetic retinopathy. The research concerned elderly patients, 60 years or over, suffering from diabetes mellitus. Four hundred and nineteen elderly diabetics were studied, using the *willingness to pay* method that is included in the cost-benefit analysis. The subjects of the research were interviewed and the only criteria, according to which diabetics were chosen, were their age (over sixty years old) and the fact that all of them were suffering from diabetes mellitus. The research took place during the period from July 2007 to June 2010.

As far as the process of the interview is concerned, initially, a written consent was received from the patients, and further their demographic data were collected. They were then informed about diabetic retinopathy and a realistic scenario was presented to the elderly diabetic patients. According to the scenario, patients were asked to declare the highest sum of money that they were willing to pay in order to reduce the risk of diabetic retinopathy from 90% to 60%, to 30% and to 0%. Furthermore, each patient was asked to indicate in a 10-degree scale, the importance of the risk reduction of the complication, where zero meant *by no means important* and ten *very important*. Finally, the participants were asked if they suffered from the particular complication, as well as if he /she presented certain symptoms of diabetic retinopathy.

Table 1
Sample's socioeconomic characteristics

Characteristics	
Mean age (years) (SD)	69.48 (7.956)
Female's mean age (years) (SD)	70.75 (8.694)
Male's mean age (years) (SD)	68.13 (6.853)
Females (%)	51.6
Married (%)	73.5
Mean number in household	1.16
Pensioners (%)	64.7
Smoking Habits Smokers (%)	35.3
2-10 cigarettes per day	9
11-20 cigarettes per day	5.9
21-30 cigarettes per day	13.8
31-40 cigarettes per day	2.2
41-50 cigarettes per day	4.3
Alcohol Drinking Habits Percentage of participants consuming alcohol (%)	33.4
1-4 glasses per week	21.2
5-8 glasses per week	10
> 8 glasses per week	2.4
Monthly Household income (%)	
€ 0-500	13.8
€ 501-1000	28.9
€ 1001-1500	18.1
€ 1501-2000	16,5
€ 2001-2500	6
€ 2501-3000	8.8
€ >3000	7.9
Education (%)	
Without complete primary education	13.8
Primary school	43.2
High school	26
University degree	16.9

SD: Standard deviation

The statistical analysis which was held was the following. The SPSS statistical package for the Social Sciences (version 16) was used. The One-Sample Kolmogorov Smirnov Test was used in order to check which quantitative variables followed a normal distribution. A Mann-Whitney N Test was performed in order to check the relation of all factors, which did not follow the normal distribution (none followed a normal distribution as it resulted from the Kolmogorov Smirnov Test), with regards to gender. Still, diabetics were categorized according to the level of education, where a Kruskal-Wallis H Test was performed in order to check whether a difference between the various levels of education exists. Then, for all the variables with $p \leq 0.05$, a comparison of medians between the various levels of education followed, with the use of Mann-Whitney N Test. Similarly, the same process was followed for the study of years that these patients had been suffering from diabetes, for the knowledge of patients close to them who were suffering from diabetes mellitus as well, for the knowledge of existence of diabetic retinopathy and for the height of monthly family income. Finally, a logistic univariable and multivariable regression was carried-out, in order to check which factors influence the *willingness-to-pay* of the sample.

RESULTS

A total of 419 diabetics, aged 60 years or more, 216 of which were females, were interviewed. They all held public health insurance, but only 8 of them had additional private medical coverage. Main public health insurance for the 32.7% of them was the Social Security Organization (IKA). Males consumed more alcohol and smoked more, in comparison to females. Their socioeconomic characteristics are presented in Table 1.

The sample's clinical characteristics were also examined. Patients were asked how often they

visited a doctor, if and, if yes, how often they had their blood glucose measured, how many years they suffered from diabetes mellitus and if they had developed diabetic retinopathy. Their clinical characteristics are presented in Table 2.

With regard to the control of diabetes mellitus, patients checked their disease with frequent visits to the doctor, as well as with measurement of glucose levels in their blood, using self-monitoring instruments. This way of self-monitoring is widely widespread among diabetic patients, as it is considered to be a fast, easy and valid way of measurement, while manufacturers usually offer them free of charge to diabetics and insurance funds cover 75% to 100% of Test Strips' cost. Nevertheless, one third of the patients (32.2%) did not check their glucose on their own, while a 36.3% percentage of elderly diabetics were submitted to 1 medical check-up annually and a 30.8% to 2 medical check-ups per year. However, a percentage of elderly diabetics (10.7%) were not submitted to medical control (Table 2). As for the type of treatment that patients followed in order to confront diabetes mellitus, a percentage of 55.4% diabetics applied a combination of pharmaceutical and dietary treatment, while the use of hypoglycemic pills was much more frequent (73.5%) than the use of insulin injections (26.5%). In addition, patients in their majority suffered only a few years from diabetes and there was no intense need for insulin in order to regulate and control glucose levels. Moreover, most diabetics preferred pills to insulin injections.

Table 2
Sample's clinical characteristics

Clinical characteristics	*(%)*
Hypertensive diabetics	39.6
Diabetic retinopathy	16.2
Taking exercise	26
Years suffering from diabetes mellitus	
0-5 years	
6-10 years	28.2
11-15 years	15.3
16-20 years	9.8
21-25 years	2.6
26-30 years	1.7
31-35 years	0.7
Medically checked	89.3
0 medical checks per year	10.9
0.5 medical checks per year*	5.5
1 medical checks per year	36.3
2 medical checks per year	30.8
3 medical checks per year	8.4
4 medical checks per year	6.7
6 medical checks per year	1.4
Personally checked	32.2
0 personal checks per week	57.1
0.25 personal checks per week**	0.5
0.5 personal checks per week***	1.7
1 personal checks per week	9.8
2 personal checks per week	12.4
3 personal checks per week	7.2
4 personal checks per week	3.6
5 personal checks per week	3.6
6 personal checks per week	0.2
7 personal checks per week	18.6
10 personal checks per week	0.5
14 personal checks per week	9
21 personal checks per week	0.7
Type of personal check	
blood glucose counter	94.37
urine glucose counter	2.46
blood & urine glucose counter	3.17
Medically & personally checked	64.43
Therapeutic confrontation	
Medicines	24.8
Diet	15
Medicines & diet	55.4
Nothing	4.8

**1 medical check-up per 2 years; **1 check per month*
****1 check per 15 days*

Diabetics who used insulin, were willing to pay higher percentage of their monthly family income for the reduction of risk by 90%. This seems to result due to the fact that insulin users wish to avoid injections. Besides, users of insulin were suffering from diabetes mellitus for a longer period of time (mean 17.89 years), while pill users suffered for a shorter period (mean 7.09 years). That means that insulin users were more likely to develop diabetic retinopathy, thus they were willing to pay a higher percentage of their income.

A factor that was also examined was the educational level of diabetic patients. The results showed that 43.2% of the diabetics possessed a certificate of primary school (Table1), while males were of a higher educational level. At the same time, the level of education appears to affect their willingness to pay, as a statistically important difference was found between uneducated diabetics and diabetics who had only a primary or secondary educational level. That means that diabetics with higher educational level had a higher monthly family income, they submitted themselves to more frequent medical and personal check-ups, they were willing to pay larger sums of money and higher percentage of their

monthly family income in order to reduce danger of appearance of diabetic complications to 0% and they considered the reduction of risk to be more important. Consequently, the educational level was related to the size of their income, but also to the perception of risk of the appearance of the complication and the importance of risk reduction.

Table 3
Diabetic retinopathy symptoms

Symptoms	*(%)*
	13.8
Dark spots	10.3
Trouble seeing things out of the corners of the eyes	7.4
Pain in the eye	6.4
Double vision	5
Floating spots	4.5
Sense of pressure in the eye	4.3
White /blank spots	4.3
Flashing lights	2.4
Feeling (like the presence) of a curtain in front of the eye – if a curtain has been pulled over part of what you are looking at	1.7
Loss of vision /blindness	0.5

Patients with diabetic retinopathy have symptoms such as blurred and double vision, dark or blank or floating spots, pain and pressure in the eye (Table 3) (14). From the sample of the 419 diabetic patients, 16.2% were suffering from diabetic retinopathy. Most of them (82.4%) knew that they had developed the specific complication. The most frequent symptom was blurry vision. There were also some other symptoms, such as spots, double vision and pain in the eye. The symptoms, as well as the percentage of diabetics that presented each one of them appear in Table 3. Patients who knew that they suffered from retinopathy were willing to offer larger sums of money, higher percentage of their monthly family income and they considered the reduction of risk as more important. Therefore, they submitted themselves to more frequent medical and personal check-ups.

Furthermore, each patient was asked to indicate in a 10-degree scale, the importance of risk reduction of the complication. A risk reduction of 30%, that is to say from 90% to 60%, was considered less important than the reduction of risk to 30% and to 0%. For each one of these reductions of the risk, patients gave a mean value of 6.97 for a risk reduction of 30%, a mean value of 7.92 for a risk reduction of 60% and a mean value of 9.32 for a risk reduction of 90%. Also, as the risk decreased, patients were more willing to sacrifice a higher percentage of their monthly family income. For a risk reduction of diabetic retinopathy from 90% to 60%, elderly diabetics were willing to pay €40.45 (mean) or 2.84% (mean) of their monthly family income. For a risk reduction to 30% they were willing to pay €56.84 (mean) or 3.878% (mean) of their income. For a risk reduction to 0% they were willing to pay €87.58 (mean) or 5.816% (mean) of their income. The degree of importance for the risk reduction, the frequency of check-ups, as well as the sum of money, that elderly diabetics were willing to pay in order to reduce danger of appearance of diabetic retinopathy, were influenced by the height of their monthly family income. Specifically, the higher the income, the larger the sums of money they were willing to pay.

Almost half of the diabetics (42.5%) knew other patients close to them who were suffering from diabetes mellitus as well. Those diabetics smoked less, had a smaller Body Mass Index, they submitted themselves to more frequent check-ups, they considered the reduction of risk as more important and they were willing to pay larger sums of money and higher percentage of their monthly family income in order to buy a drug that would reduce the appearance of the risk by 30%, 60% and 90%.

Moreover, an important proportion of the diabetics (41.8%) knew that suffered from diabetes mellitus for up to 5 years. Patients, who suffered from diabetes mellitus for 11 to 20 years, submitted themselves to more frequent medical and personal check-ups, they smoked less, they considered the reduction of risk more important and they were willing to pay a larger percentage of their monthly family income, compared to patients who suffered for a shorter period of time (0-10 years). No statistically significant difference was observed between diabetics who suffered for 11 to 20 years and the ones who suffered for 21 to 30 years, due to the exceptionally small sample of individuals (hardly twenty-one) who suffered for 21-30 years.

Finally, diabetics' willingness to pay was examined in terms of the length of period that they suffered from diabetes mellitus and the study

concluded that the willingness to pay is influenced by the time that has passed since the outbreak of the disease; that is to say patients suffering from diabetes for longer period of time, intend to give a higher percentage of their monthly family income in order to reduce the risk of the appearance of diabetic retinopathy.

CONCLUSION

Diabetics' willingness to pay large amounts seems to be in accordance with the number of years they have had diabetes mellitus. That is to say patients suffering from diabetes a longer period of time (more than 10 years), intend to give higher percentage of their monthly family income. The univariable and multivariable logistic regression, led to the conclusion that the length of the period that the patients suffered from the illness, influenced their willingness to pay and in fact, as the illness progressed, the percentage of income that they were willing to pay in order to reduce the risk of diabetic retinopathy to 60%, 30% and 0%, increased. That is to say, diabetics who approached the limit of 20 years - where the risk of appearance of the complication was 90% - were willing to pay more in order to decrease the risk. Patients considered a risk reduction of just 30%, that is to say a reduction of risk from 90% to 60%, as an indeed important benefit.

In conclusion, the findings of this willingness to pay study showed that reducing the risk of the appearance of diabetic retinopathy is a major concern especially to patients knowing other patients with diabetes mellitus, patients using insulin, as well as diabetics suffering from diabetes mellitus for a longer time. However, there are substantial socioeconomic differences concerning their educational level, as well as their monthly family income, in how patients with diabetes mellitus value benefit from reducing the risk of diabetic complications. Finally, patients who knew that they had developed diabetic retinopathy were willing to pay more money to reduce the risk of developing the particular complication.

Conflicts of Interest: The author declares no conflicts of interest regarding the publication of this paper.

REFERENCES

1. Karamitsos T.D.: Diabetes Mellitus, Undergraduate lessons. P.5, 21, University Studio Press, Thessalonica, 1986
2. Moore W.T., Eastman C.R.: Diagnostic Endocrinology. P. 263, Mosby, USA, 1996
3. American Diabetes Association (ADA). Diabetes and Retinopathy (Eye Complications). (2007) Available at: http://www.diabetes.org/diabetes-statistics/eye-complications.jsp
4. Tountas D.Ch.: Diabetes Mellitus - Theory - Practice. P. 756, Athens, 2003
5. Centres for Disease Control and Prevention (CDC). National Diabetes Fact Sheet 2011 Available at: http://www.cdc.gov/diabetes/pubs/pdf/ndfs_2011.pdf
6. Centres for Disease Control and Prevention (CDC). Public health focus: prevention of blindness associated with diabetic retinopathy. *MMWR 42*: 191-195 (1993)
7. O'Brien A.J., Patrick R.A., Caro J.J.: Cost of managing complications resulting from type 2 diabetes mellitus in Canada. *BEMS Health Services Research 3*: 7 (2003)
8. Spinthouri K.M.: Cost-Benefit Analysis with the "Willingness to pay" method of preventive pharmaceutical therapy against emesis in patients suffering from cancer who are submitted to chemotherapy. Dissertation, Faculty of Nursing, National and Kapodistrian University of Athens, Athens, 2003: 99, 195
9. Rice D., Hodgson T.: The value of human life revisited. *Am. J. Public Health 72*: 536-537 (1982)
10. Drummond F.M., O' Brien J.B., Greg S.L., George T.W.: Methods of economic evaluations of health care programs. Athens: *Kritiki 318*: 335-338 (2002)
11. Donaldson C., Thomas R., Torgerson J.D.: Validity of open-ended and payment scale approaches to eliciting willingness to pay. *Applied Economics 29*: 79-84 (1997)
12. Gafni A.: Using willingness-to-pay as measurement of benefits. *Med. Care 29*: 1246-1252 (1991)
13. O' Brien B.J., Gafni A.: When do dollars make sense? Toward a conceptual framework of contingent valuation studies in health care. *Med. Decis. Making 16*: 288-299 (1996)
14. National Diabetes Information Clearinghouse (NDIC). Prevent diabetes problems: keep your eyes healthy. (2010) Available at:
http://diabetes.niddk.nih.gov/dm/pubs/complications_eyes/index.htm