

Open Access Article **Study**

Willingness to Pay Analysis of Elderly Diabetics for Confronting Diabetic Nephropathy and Diabetic Neuropathy

Chrisi Vlachou and Theofanis Katostaras

Faculty of Nursing, School of Health Sciences, National and Kapodestrian University of Athens, Greece

Key words: Willingness-to-pay, contingent valuation, diabetic nephropathy, diabetic neuropathy, diabetics, income

Citation: C. Vlachou, T. Katostaras. Willingness to Pay Analysis of Elderly Diabetics for Confronting Diabetic Nephropathy and Diabetic Neuropathy. Rev. Clin. Pharmacol. Pharmacokinet., Int. Ed. 2020, 34,1, 23-30.

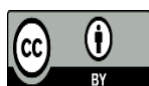
<https://doi.org/10.5281/zenodo.10050472>

Received: 24 October 20219

Accepted: 23 December 2019

Republished: 28 October 2023

Publisher's Note: PHARMAKON-Press stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2023 by the authors.

Licensee PHARMAKON- Press, Athens, Greece. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license.

(<http://creativecommons.org/licenses/by/4.0/>).

Corresponding author: Chrisi Vlachou, Faculty of Nursing, School of Health Sciences, National and Kapodestrian University of Athens, Greece, Email: chrisivlachou@yahoo.com; vlachouchrisi@gmail.com

S u m m a r y. Introduction: Diabetic neuropathy (DNU) and nephropathy (DNP) are frequent diabetes mellitus (DM) complications, and incidence increases with diabetes duration: patients with DM for 20 years have 90% probability for DNU and 40% for DNP.

Aim: This study was conducted to measure how diabetic patients value risk reduction of DNU and DNP, and estimate the maximum amount of money and percentage of monthly income these patients would pay for reduction of DNU and DNP 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 DNU risk by 30%, 60% or 90% and DNP risk by 20% or 40%. 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 DNU, DNP or symptoms, and whether patients knew someone with DNU or DNP.

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 DNU or DNP) 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 DNU were willing to pay more for risk reduction ($p=0.002$, $p=0.002$ and $p=0.001$ for reduction by 30, 60 and 90%, respectively). Patients having DM for >10 years were willing to pay more

(DNP: $p=0.000$, $p=0.000$ for risk reduction by 20 and 40% respectively, DNU: $p=0.031$, $p=0.028$ and $p=0.003$ for risk reduction by 30, 60 or 90% respectively). Diabetics using insulin were willing to pay more for risk reduction to 0% ($p=0.002$ for DNP, $p=0.003$ for DNU). Diabetics knowing other diabetics were also willing to pay more (DNP: $p=0.047$ and $p=0.004$ for reduction by 20% and 40%, respectively; DNU: $p=0.025$ for 30% and 90% reduction and $p=0.019$ for 60% reduction). Higher education and income were associated with willingness to pay more for risk reduction.

Conclusions: DNU and DNP risk reduction is important to DM patients, especially those having DM for >10 years, suffering from DNU and DNP or knowing someone with DM. Education and monthly income significantly influence the perceived value of DNU and DNP risk reduction.

INTRODUCTION

Diabetes mellitus (DM) is a metabolic syndrome that is caused due to absolute or relative insufficiency of insulin secretion or even decreased sensitivity of tissues in the action of this hormone. It is often accompanied by the appearance of complications. Diabetic nephropathy (DNP) and diabetic neuropathy (DNU), as well as diabetic retinopathy are frequent complications, specific to DM (1). DNP occurs in 20–40% of patients with DM and is the single leading cause of end stage renal disease (2). DNP develops in, at most, 40% of patients with DM, even when high glucose levels are maintained for long periods of time (3). Moreover, 35-45% of insulin dependent diabetics develop nephropathy, as well as 20-35% of non insulin dependent (4). The appearance of DNP depends mainly on the duration of the disease and thus a diabetic who suffers from DM for a period of 20 years, has a 35-40% probability to develop DNP (5, 6).

The incidence of DNU varies from 10 to 90%, depending on the clinical and laboratory criteria used in order to detect it. Thus a diabetic who suffers from DM has a 5% to 100% probability to develop DNU, based on the diagnostic criteria used (7). Prevalence data for DNU range from 1.6 to 90% depending on tests used, populations examined, and type and stage of disease (8). A diabetic, who suffers from DM for a period of 20 years, has a 10-100% probability to develop DNU, based on the diagnostic criteria used (5).

The conduction of analyses that evaluate the cost of confrontation of these complications is necessary, because of the increasing number of diabetics, the high prevalence and chronicity of the disease, the severity and frequency of the complications and the financial burden of the disease and its complications. Subject of this

research is the measurement of the value that elderly diabetic patients attribute to the risk reduction of the appearance of DNP and DNU, using the "willingness-to-pay" method.

METHOD

"Willingness - to - pay" method was selected, since the expected benefit (risk reduction of appearance of DNP and DNU) could be determined and patients knew precisely what they were paying for (9). 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 (9, 10). 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 has no "instigator" and is not motivated (11, 12). In this way, bias is avoided in the beginning, while it is not avoided 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 (11). 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 DNP and DNU was measured using an approach of contingent valuation, which measures the willingness to pay for a given health benefit (13, 14). 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 (11). 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 (13, 14).

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 DNP and DNU. The research included elderly patients, 60 years or over, suffering from DM. Four hundred and nineteen (419) 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 DM.

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 DNP and DNU 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 DNP from 40% to 20% and to 0% and the risk of DNU 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 complications, where zero meant "by no means important" and ten "very important". Finally, the participants were asked if they suffered from the particular complications, as well as if he /she presented certain symptoms of DNP and DNU.

The statistical analysis which was held was the following. The SPSS statistical package for the Social Sciences 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 DM as well, for the knowledge of existence of DNP, for the knowledge of existence of DNU and for the height of their 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. A certain income percentage was used as binary dependent variable and all

variables with $p < 0.05$ were considered significant.

RESULTS

A total of 419 diabetics, aged 60 years or more, 216 of which were females, were interviewed. Their socioeconomic characteristics are presented in Table 1, while their clinical characteristics are presented in Table 2.

With regard to the control of DM, patients checked their disease with frequent visits to the doctor, as well as with self-monitoring instruments which measure glucose levels in their blood. This way of self-monitoring is 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. 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 (10.9%) were not submitted to medical control (Table 2). As for the type of treatment that patients followed in order to confront DM, 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. Diabetics, who used insulin, were willing to pay higher percentage of their monthly family income for the reduction of risk to 0%. Insulin users were suffering from DM 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 DNP and DNU, 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 (Table 1), while males were of a higher educational level. The level of education appears to affect their willingness to pay. 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. Patients with DNP or DNU have a variety of symptoms (Table 3). From the sample of the 419 diabetic patients, 1% were suffering from DNP and 34,8% from DNU. More than half of them (58.2%) knew that they had developed DNU and all (100%) knew that they had developed DNP. The most frequent symptoms of DNU were tingling, numbness, prickling, cramps and burning sensation in the hands and feet. There were also other symptoms, such as contractions, dizziness urinary incontinence, gastroparesis, increased heart rate and more. 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 neuropathy 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 complications. As far as it concerns DNP, a risk reduction of 20%, that is to say from 40% to 20%, was considered less important than the reduction of risk to 0%. For each one of these reductions of the risk, patients gave a mean value of 7.76 for a risk reduction of 20% and a mean value of 9.38 for a risk reduction of 40%. As far as it concerns DNU, 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 6.10 for a risk reduction of 30%, a mean value of 7.18 for a risk reduction of 60% and a mean value of 8.73 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 DNP from 40% to 20%, elderly diabetics were willing to pay €53.85 (mean) or 3.469% (mean) of their monthly family income. For a risk reduction to 0% they were willing to pay €84.03 (mean) or 5.426% (mean) of their income. For a risk reduction of DNU from 90% to 60%, elderly diabetics were willing to pay €31.10 (mean) or 2.218% (mean) of their monthly family income. For a risk reduction to 30% they were willing to

pay €42.68 (mean) or 2.994% (mean) of their income. For a risk reduction to 0% they were willing to pay €58.78 (mean) or 4.177% (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 DNP and DNU, 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 DM 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 risk of DNP for 20% and 40% and the appearance of risk of DNU for 30%, 60% and 90%.

Moreover, an important proportion of the diabetics (41.8%) knew that suffered from DM for up to 5 years. Patients, who suffered from DM 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 DM. Diabetics who suffered from DM for more than 10 years were 2,634 to 8,972 times more willing to pay 3% or more of their income, in order to reduce the risk of the appearance of DNP to 20% compared to diabetics who suffered 10 years or less. Diabetics who suffered from DM for more than 10 years were 1,085 to 1,327 times more willing to pay 4,5% or more of their income, in order to reduce the risk of the appearance of DNP to 0% compared to diabetics who suffered 10 years or less. Diabetics who suffered from DM for more than 10 years were 1,016 to 1,403 times more willing to pay 1,5% or more of their income, in order to reduce the risk of the appearance of DNU to 60% compared to diabetics who suffered 10 years or less. Diabetics who suffered from DM

for more than 10 years were 1,039 to 1,921 times more willing to pay 2% or more of their income, in order to reduce the risk of the appearance of DNU to 30% compared to diabetics who suffered 10 years or less. Diabetics who suffered from DM for more than 10 years were 1,141 to 1,953 times more willing to pay 3% or more of their income, in order to reduce the risk of the appearance of DNU to 0% compared to diabetics who suffered 10 years or less. Therefore, 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 DNP and DNU.

CONCLUSION

Diabetics' willingness to pay large amounts seems to be in accordance with the number of years they have had DM. 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 DNP to 20% and 0% and of DNU 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 40% and 90% respectively - were willing to pay more in order to decrease the risk.

Moreover, as the risk of appearance of DNP and DNU decreased, due to the use of the drug, diabetics were willing to pay larger sums of money and a higher percentage of their monthly family income, in order to buy that drug. Furthermore, diabetics who considered a risk reduction of 20% or 40% (as far as it concerns DNP) as more important, they were willing to pay a higher percentage of their monthly family income in order to reduce the risk by 20% or 40%. Similarly, diabetics who considered a risk reduction of 30%, 60% or 90% (as far as it concerns DNU) as more important, they were willing to pay a higher percentage of their monthly family income in order to reduce the risk by 30%, 60% or 90%.

In conclusion, the findings of this willingness to pay study showed that reducing the risk of the appearance of DNP and DNU is a major concern especially to patients knowing other patients with

DM, patients using insulin, as well as diabetics suffering from DM 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 DM value benefit from reducing the risk of diabetic complications. That is to say, diabetics with higher income and higher educational level were willing to pay larger sums of money in order to reduce the appearance of risk of DNP and DNU. Finally, patients who knew that they had developed DNU, or suffered from tingling or numbness, were willing to pay more money and a higher percentage of their monthly family income, in order 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. Nathan D M. Long-term complications of diabetes mellitus. *N Engl J Med.* 1993;328:1676-1685.
2. American Diabetes Association. Standards of Medical Care in Diabetes – 2011. *Diabetes Care* 2011;34(1):11-61.
3. Gross L J, de Azevedo J M, Silveiro P S, Canani L-H, Caramori M-L, Zelmanovitz T. Diabetic Nephropathy: Diagnosis, Prevention, and Treatment. *Diabetes Care* 2005;28(1):164-176.
4. Moore W. T., Eastman C. R. *Diagnostic Endocrinology.* Mosby, USA, 1996, p. 263, 270.
5. Tountas D. Ch. *Diabetes Mellitus – Theory – Practice.* Athens, 2003, p.759, 825, 841.
6. Centers for Disease Control and Prevention. National Chronic Kidney Disease Fact Sheet: General Information and National Estimates on Chronic Kidney Disease in the United States, 2010. Atlanta, GA: U.S. Department of Health and Human Services, CDC; 2010.
7. Millán-Guerrero R O, Trujillo-Hernández B, Isais-Millán S, Prieto-Díaz-Chávez E, Vásquez C, Caballero-Hoyos J R, García-Magaña J. H-reflex and Clinical Examination in the Diagnosis of Diabetic Polyneuropathy. *The Journal of International Medical Research*, 2012;40(2):694-700.
8. Boulton J M A, Vinik I A, Arezzo C J, Bril V, Feldman L E, Freeman R, Malik A R, Maser E R, Sosenko M J, Ziegler D. Diabetic Neuropathies. A statement by the American Diabetes Association. *Diabetes Care* 2005;28(4):956-962.

9. 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.
10. Rice D, Hodgson T. The value of human life revisited. *Am J Public Health* 1982;72:536 – 537.
11. Drummond F. M., O' Brien J. B., S. L. Greg, T. W. George. *Methods of economic evaluations of health care programs*. Athens: Kritiki, 2002: 318, 335-338.
12. Donaldson C., Thomas R., Torgerson J. D. Validity of open-ended and payment scale approaches to eliciting willingness to pay. *Applied Economics* 1997; 29:79-84.
13. Gafni A. Using willingness-to-pay as measurement of benefits. *Med Care* 1991; 29:1246-1252.
14. O' Brien BJ, Gafni A. When do dollars make sense? Toward a conceptual framework of contingent valuation studies in health care. *Med Decis Making* 1996; 16:288-299

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 (0.906)
Pensioners (%)	64.7
Smokers (%)	35.3
Alcohol consumers (%)	33.4
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
<i>SD = standard deviation</i>	

Table 2. Sample's clinical characteristics

Clinical characteristics	(%)
Hypertensive diabetics	39.6
Diabetic nephropathy	1
Diabetic neuropathy	34.8
Taking exercise	26
Years suffering from diabetes mellitus	
0-5 years	41.8
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	67.8
0 personal checks per week	32.2
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	
<i>blood glucose counter</i>	94.37
<i>urine glucose counter</i>	2.46
<i>blood & urine glucose counter</i>	3.17
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	

Table 3. Diabetic nephropathy and neuropathy symptoms

Diabetic Nephropathy Symptoms	(%)
Swelling	0.7
Fatigue	0.5
Yellow skin	0.5
Stomach disorders	0.2
Dialysis	0.2
Kidney transplant	0.2
Diabetic Neuropathy Symptoms	(%)
Tingling sensation (feet/hands)	28.2
Numbness sensation (feet/hands)	23.6
Prickling sensation (feet/hands)	23.2
Cramps (feet/hands)	21
Burning sensation (feet/hands)	13.4
Contractions (feet/hands)	13.1
Dizziness/fainting when changing position	12.9
Urinary incontinence	12.4
Gastroparesis	12.2
Sharp pain of hands/feet	11.2
Increased heart rate	10.7
Eye adjustment difficulties in light intensity changes	10.7
Loose sense of bladder	7.2
Increased sensitivity to touch	6.7
Itching	6.7
Loose sense of need to urinate/urinary retention	5.5
Loss of reflexes	3.3
Excessive sweating	3.1
Eye focusing problem	3.1
Reduced ability to feel pain or temperature changes	2.6
Change shape of hand/feet	2.6
Hypoglycemia unawareness	1.7
Double vision	1.7
Esophageal paresis	1.2
Erectile dysfunction	0.5
Vaginal dryness	0.2
Loss of vaginal sensitivity	0.2
Facial paralysis	0.2
Impotence	0
Reciprocal ejaculation	0