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ORIGINAL RESEARCH

The diabetes epidemic in Malta

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Abstract

Aim: The small European Mediterranean island state of Malta is a highly prevalent type 2 diabetes (T2DM) country. Over recent decades drastic environmental, cultural and ethnic changes occurred and it was considered timely to undergo a cross-sectional survey to establish up-to-date prevalence of T2DM, its socio-geographical distribution and ultimately estimating the economic burden of T2DM.

Methods: A health examination survey was conducted (2014-16) including a representative sample of the adult population stratified by 18-70 years, gender and locality *(n*=3,947; males *n*=1,997 male*)*. The survey consisted of a socio-demographic questionnaire, various health examination measurements and blood samples for fasting blood glucose (FBG). Prevalence for T2DM (depending on medical history, medication and FBG >7mmol/L) were calculated for the general population as well as for each of the districts making up the Maltese Islands. The economic burden of T2DM for 2017 and projected burden for 2045 were calculated using secondary sources and by incorporating 2% compound interest per annum respectively.

Results: A total response rate of 47.15% was obtained, with a mean age of 48 years for males and 46 years for females. Out of the total adjusted population (*n*=3,947, male *n*=1,998), the prevalence of T2DM was of 10.31%, with 6.31% already known to have T2DM while 4% were newly diagnosed. Females were diagnosed with T2DM at an earlier age than the males. No significant geographical T2DM prevalence differences were established. The total annual diabetes health care expenditure was approximately €107,316,517.82 for 2017, while the projected expenditure for 2045 was estimated at €244,136,040.

Conclusion: Malta is a country with a high prevalence of diabetes. The females were observed to be at an earlier risk of developing undiagnosed diabetes compared to males. Although geographical location did not appear to have significant effect on T2DM distribution, this disease contributes to a high economic burden. The expected exponential increase in diabetes prevalence is subsequently expected to affect negatively the healthcare expenditure. This puts forward the recommendation for development of early screening programmes as part of preventive action strategies.

Keywords: *diabetes, epidemic, health care, health expenditures, mass screening, type 2 diabetes.*

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Conflicts of interest: None declared.

Introduction

Type 2 diabetes mellitus (T2DM) is a global epidemic with an estimated 463 million adults (20-79 years) suffering from this condition in 2019 (1). The Mediterranean island of Malta is no exception. In Malta, diabetes has been reported to be a health problem since the eighteenth century (2). The first epidemiological study aiming at assessing the prevalence of T2DM in Malta was conducted in 1964 (3). In 1981, the World Health Organization (WHO) conducted the first national representative diabetes prevalence study in Malta (4). More recently, a pilot study was conducted in 2010 - the European Health Examination Survey (EHES) (5). This gave an estimate of the diabetes burden in Malta (5). Different studies reported increasingly higher diabetes prevalence within the Maltese population, often higher than neighbouring countries (1). Consequently, Malta was considered a Mediterranean hub for diabetes (6). Over recent years, Malta has sustained a cultural change, with more ethnical and socio-economic diversity, and new variety in the genetic imprints, as well as a shift to a more Westernised lifestyle (7). All these factors are contributors for population metabolic transition, which could possibly increase the diabetes prevalence within the Maltese population (7).

A national representative survey was undertaken between 2014 and 2016 to update the dysglycaemic status of Malta (8). It was hypothesised that with the drastic environmental, cultural and ethnic changes that have occurred in Malta over the past few decades, the prevalence of T2DM and its distribution among the population have altered from the previous studies. The aim of this study was to update the prevalence of T2DM in Malta as well as to determine the socio-geographical distribution of the disease and ultimately estimate the economic burden

Methods

The University of Malta conducted a nationally representative health examination survey (2014 – 2016) entitled SAHHTEK (*your health*). The detailed study methodology can be found elsewhere (8). Briefly, a population-based sample stratified by age (18-70 years), gender and locality (approximately 1% from each of the 68 towns) was obtained from a national register. The selected individuals (n=3,947; males n=1,998) with a mean age of 48 years for males and 46 years for females, were invited to participate in the survey that consisted of a previously validated questionnaire, blood pressure measurements, weight, height, waist circumference and hip circumference measurements. Blood samples for fasting blood glucose and a lipid profile were also gathered. Informed written consent was obtained from every participant. Ethical and data protection approvals were granted from the University of Malta Research Ethical Committee (UREC) and the Information and the Data Protection national commissioner, respectively.

Participants obtaining a fasting blood glucose (FBG) level between 5.60 to 6.99 mmol/L were referred to as *Impaired Fasting Glucose* (IFG), while those with a FBG >=7 mmol/L were considered as *newly diagnosed diabetes mellitus*, provided they were not previously diagnosed as diabetics or were on oral hypoglycaemic agents (9). Participants with a previous history of diabetes mellitus or on oral hypoglycemic agents, irrespective of their measured fasting plasma glucose, were considered as cases of *previously diagnosed diabetes mellitus*.

The global T2DM prevalence level was calculated by dividing the sum of newly diagnosed and previously diagnosed diabetics over the total number of participating individuals. The prevalence levels for previously diagnosed diabetes and newly diagnosed diabetes were established separately and in total. The prevalence levels were stratified by age and gender and compared to the previously reported prevalence levels by the WHO 1981 study (4).

Following the Eurostat system of Local Administrative Units (LAUs), the diabetes prevalence was stratified into the six districts of Southern harbour, Northern harbour, South Eastern, Western, Northern and Gozo districts (10). For each district, the T2DM prevalence level (global, previously and newly diagnosed T2DM) were calculated.

The economic burden of T2DM was calculated by multiplying the total diabetic Maltese population by the estimated mean diabetes-related expenditure per person for Malta as reported by the International Diabetes Federation (IDF) Atlas in 2017 (11). This expenditure incorporated the provision of health services (preventive and curative), family planning activities, nutritional activities, emergency aid for both public and private healthcare expenditures (11). The original IDF estimation for healthcare expenditure was based on the IDF diabetes prevalence (an over-estimation for Malta), the United Nations population estimates, the WHO annual health care expenditure and mortality rates, as well as ratios of healthcare expenditure for diabetics compared to non-diabetics (11-14).

The progressive diabetes prevalence between the two-health examination surveys (1981 and 2016) was

calculated, while assuming that the progressive prevalence level remained constant across the 35 years duration. This progressive prevalence level was utilized to project the diabetes prevalence for the year 2045. The previously calculated diabetes expenditure per person was also projected for the year 2045 by incorporating a 2% compound interest increase per annum (15). Using the EUROSTAT projected total Maltese population for the year 2045, the projected diabetes prevalence level for 2045 was then estimated (16). This 2045 diabetes population estimate was used to estimate the diabetes economic burden.

Results

A total of 3,947 adults (1,998 male and 1,949 female) were invited to participate in the health examination survey held between November 2014 and November 2015. Of these, 1,861 adults (836 male and 1,025 female) participated, giving a response rate of 47.15% (p=<0.01). Since the responders were found to be significantly different from the non-responders, a weighting factor was applied to each of the responder. The weighting factor enabled the data to maintain its representative nature by ensuring that each town was represented by 1% by each age and sex. A detailed description of the weighting protocol can be found elsewhere (8). The final weighted (adjusted) population was of 3,947 (males n=1998), of whom 10.31% (CI 95%: 9.40%-11.30%) suffered from diabetes mellitus. This included those previously diagnosed (6.31%, CI 95%: 5.59%-7.11%), as well as newly diagnosed (4.00% CI 95%: 3.43%-4.66%) diabetics. Comparing this study's results to the last nationally representative study (1981), an increase in diabetes prevalence rate was observed (Figure 1). A steeper increase was observed between 1981 and 2016 amongst the newly diagnosed diabetics. A slight increase was also observed when the current study was compared to the European health examination pilot study (n=212) conducted in 2010 (total diabetes prevalence of 9.8%).

On age and gender stratification of the diabetes prevalence, the female population exhibited an earlier onset of diabetes mellitus (30-39 years) when compared to the male population (40-49 years) amongst the current study population. Figure 2 compares the global diabetes prevalence levels between the 1981 and 2016 studies, by age group and gender. A more evident difference in the diabetes prevalence levels could be observed between the two studies amongst the elderly population (70 years).

Figure 1. Comparison between the diabetes prevalence rate amongst the WHO 1981 and SAHHTEK 2014 – 2016 studies

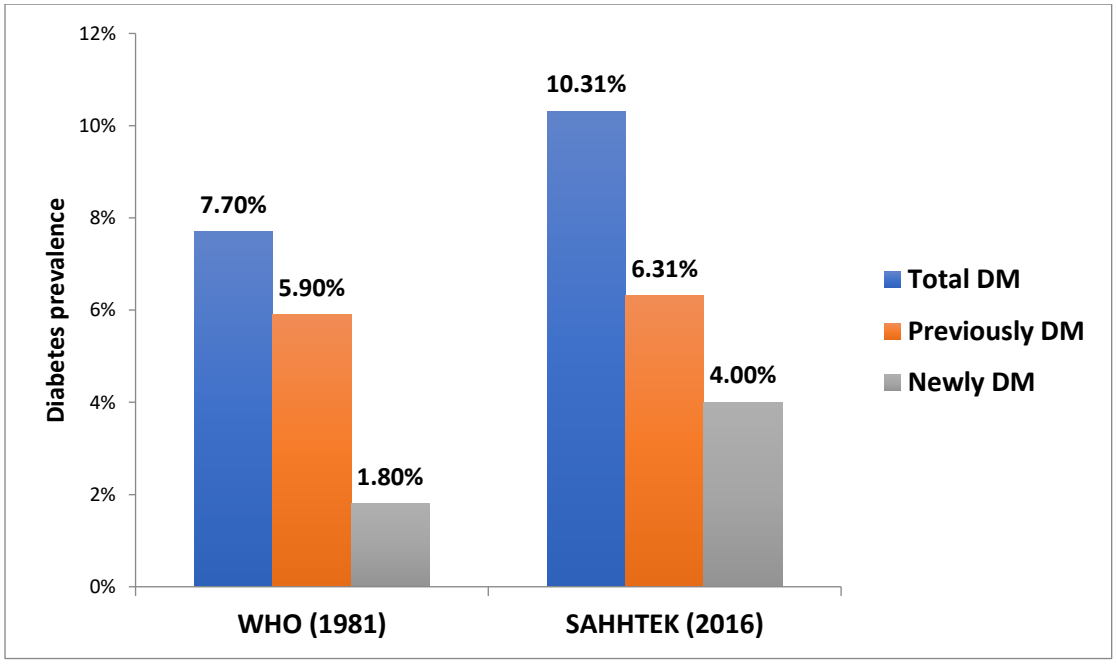
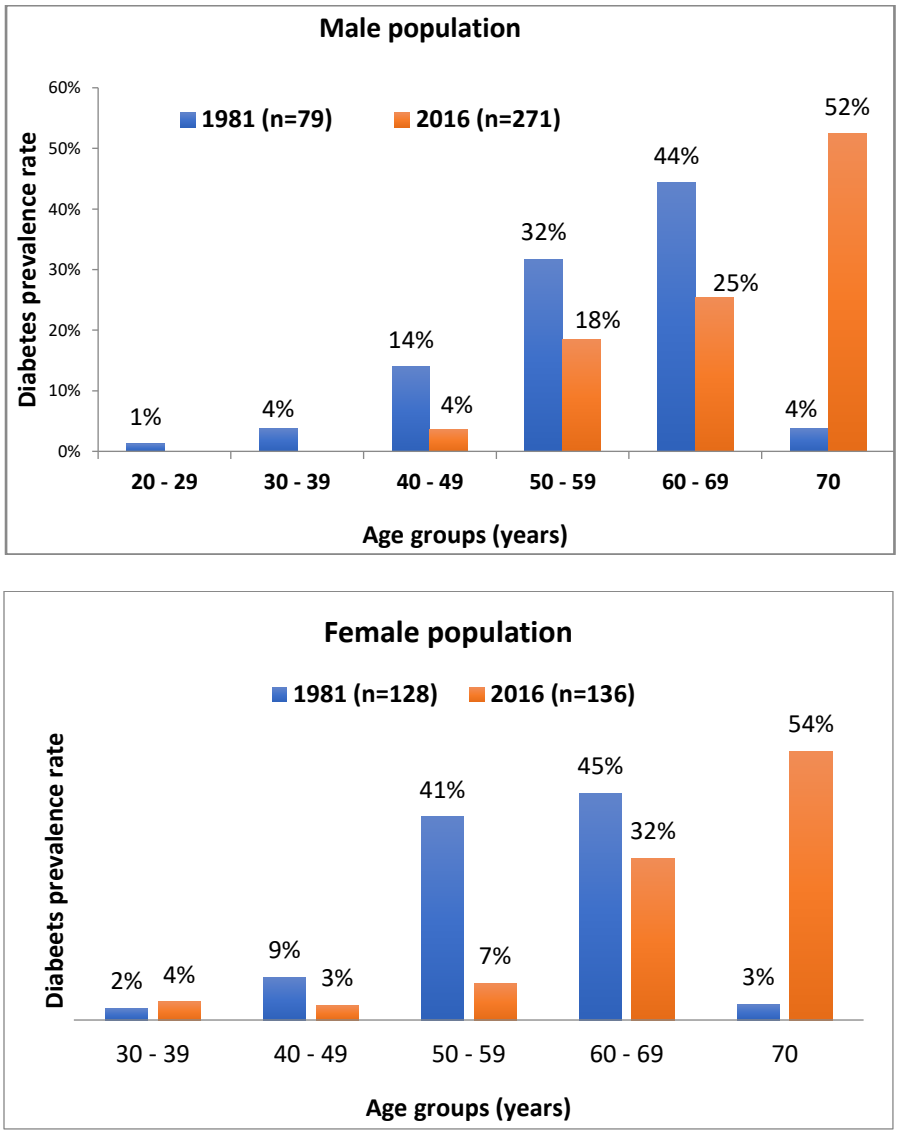
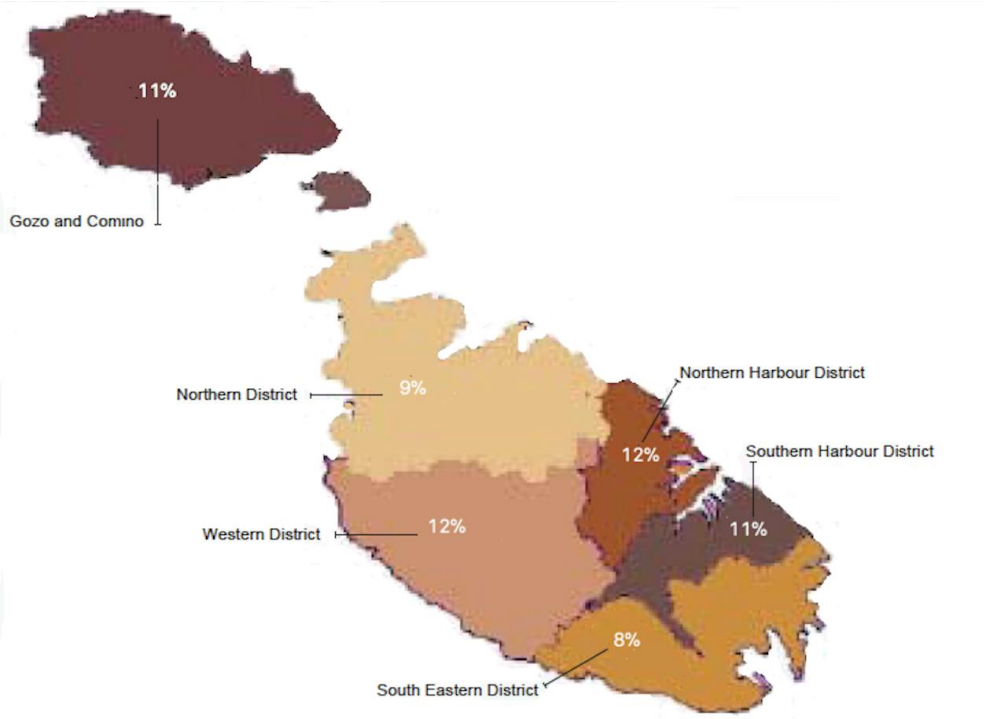


Figure 2. Diabetes prevalence rates amongst the WHO 1981 and SAHHTEK 2014 – 2016 studies, by age groups and gender



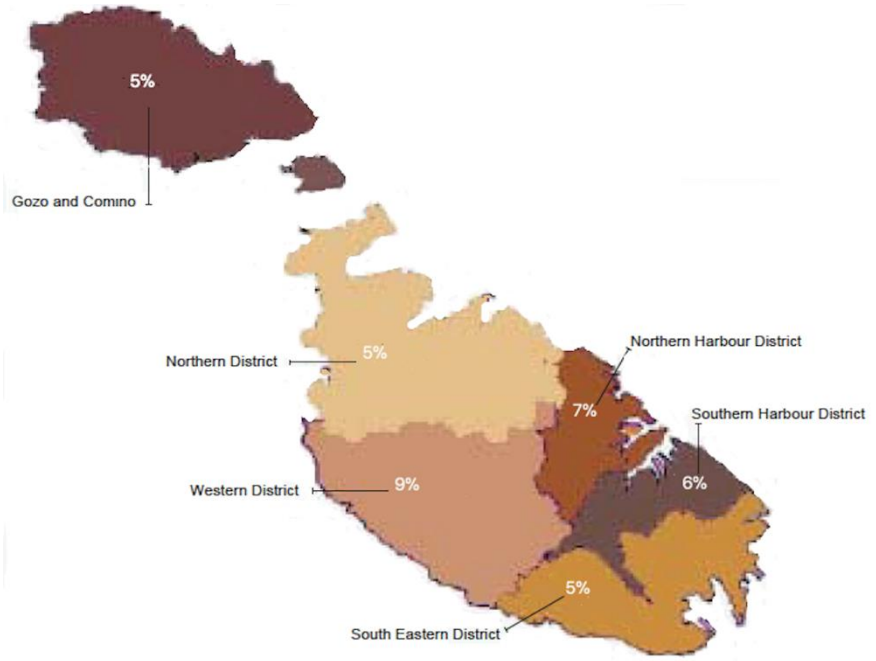
The diabetes prevalence differed across the six districts (p=0.10), with the Northern harbour and the Western districts exhibiting the highest global diabetes prevalence rates (Figure 3). The Southern harbour, Northern harbour and Gozo districts had the same newly diagnosed diabetes prevalence level of 5%. While the Western, South Eastern and Northern districts had lower 3% of newly diagnosed diabetes prevalence level each (p=0.47) (Figure 4). The Western district exhibited the highest previously diagnosed diabetes prevalence level as compared to the other districts (p=0.15) (Figure 4).

Figure 3. Global diabetes prevalence levels by district in Malta 2014 – 2016

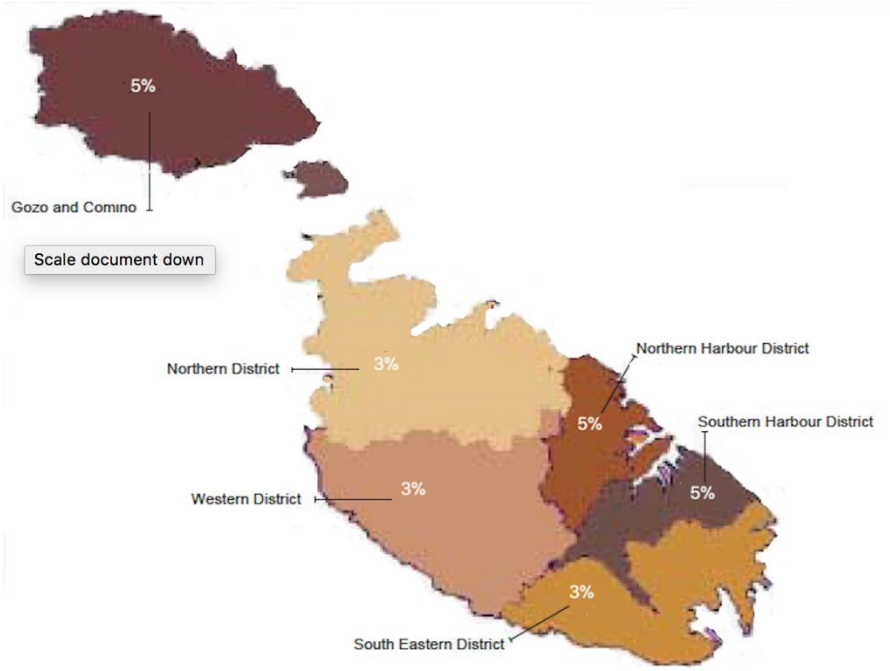


The Maltese diabetes economic burden for 2017 was estimated to be €2,416 per diabetic individual per year (11). Considering the global diabetes prevalence of 10.31% and the total Maltese adult population for 2017 to be 430,835 people, the total annual diabetes health care expenditure was estimated to be approximately €107,316,517.82 (€97,844,351.84 – €117,621,401.68). The projected mean diabetes expenditure per individual for the year 2045 is expected to be €4,206. While, the projected global diabetes prevalence for the year 2045 is expected to be 12.47% and the total projected Maltese population (2045) to be 465,440 adults. Hence, the total diabetes healthcare expenditure for that year would be approximately €244,136,040.

Figure 4. Previously diagnosed and newly diagnosed prevalence rates by district



A. Previously diagnosed diabetes



B. Newly diagnosed diabetes

Discussion

Diabetes mellitus type 2 is a major health and economic burden at individual, population and global levels (1,15). Over 35 years (1981 to 2016), an exponential rise was observed in the diabetes prevalence rate of Malta, which is consistent with the ongoing global epidemic (1). The majority of this rise is attributed to population growth and ageing (17). Consequently, the economic burden of diabetes will continue to increase in the years to come, particularly among the ever-aging population. Concomitantly, the global economic burden for this disease is expected to increase by 104 billion from 2017 to 2045 (11). A parallel transition is envisaged for the Maltese islands, with a projected estimated increase of €136,819,523 in the economic annual burden of the disease from 2017 to 2045. Even though the current and projected official IDF health expenditure figures are inflated, the growing economic burden of diabetes on the health system is significant and calls for action.

The geographical residing location of the Maltese population may have an effect on the diabetes burden. The highest undiagnosed diabetes levels were observed within the Northern harbour, Southern harbour and Gozo districts, even though not statistically different from the other districts, may underlie some important trends. Further research is recommended with possibility of targeted preventive actions. It is well documented that undiagnosed diabetes is subject to higher healthcare usage and therefore incur a larger healthcare expenditure (1).

The presence of diabetes mellitus was observed to become frequent from a relatively young age, especially for the female population in Malta. Considering that 1 in 10 adults in Malta eventually suffer from diabetes, it is worth considering the established criteria for early screening of this condition in the population, given its frequency and impact. In spite of the fact that international guidelines suggest that routine diabetes check-ups should initiate from the age of 45 years, it is evident that for Malta this should be even earlier and possibly from the age of 30 years (9).

Over 35 years, there has also been a shift in the gender predominance of type 2 diabetes mellitus. The current study demonstrates a male diabetes predominance contrasting with findings of the 1981 and 2010 surveys, which showed a female diabetic predominance. Similarly, a female predominance was also reported by a Norwegian health examination survey conducted between 1984 and 1986 with a gender shift on repeating the survey between 1995 and 1997 (18). This gender shift is in keeping with the rest of the world, where diabetes seemingly now affects more males than females (11). The male diabetes predominance has been reported to be due to an increasing obesity level, from a young age, when compared to the female population. This increase in obesity susceptibility could have been the result of a change in social factors (18). Nowadays, the majority of the jobs are sedentary in contrast to the early part of the past century where jobs were more labour intensive, and travelling was done by foot or bicycle (18). Furthermore, males have greater hepatic and visceral fat stores and are physiologically less insulin sensitive than females (19). Therefore, one can hypothesize that males require less weight gain than females to develop T2DM, which would explain the male diabetes predominance. In fact, it was reported that biological differences between males and females are the fundamental components for the development of T2DM (20,21). However, environmental, socioeconomic and cultural factors also play a role in T2DM susceptibility and gender differences (20-22). These may be the underlying factors contributing to the high diabetes prevalence rate. It is a very intriguing fact that Malta "excels" in diabetes and obesity rates when compared to neighbouring countries. Malta is highly dependent on imports of foods and goods especially from Sicily, which is another Island in the Mediterranean Sea, but yet, not as diabetic prevalent as Malta. This raises the question whether it is the small size of the island along with the *islandness* state that are contributing to such a health burden or is it the multi-cultural and environmental changes that took place in Malta. This calls for further research and interventions.

Study limitations

The response rate obtained was 47.15%. This was considered as an adequate response rate considering the invasive measurements performed. In fact, when compared to other European Health Examination surveys such as the Czech edition of the European Health Examination Survey (EHES) obtained a response of 31.69% (23). While the better-established SHeS in Scotland managed a response rate of 64% from all across Scotland (24). However, potential selection bias might still have occurred. Responders may have been different to non-responders and it remains difficult to remove this bias altogether. The decision to conduct weighting of the data by age, gender and towns was an effort to try to maintain the representation characteristics. Even though the population data was weighted, some subgroups still

remained with small numbers. This may have affected the power of specific subgroups statistical testing, resulting in possible type II errors. Considering that the data collection took place over a period of one-year, seasonal variations may have had an effect on the response rate as well as on the biological measures, such as blood pressure, FBG, blood lipid levels, BMI and waist circumference. The study was a health examination survey and hence clinical diagnosis could not be established. However, being a health examination survey high-risk population for particular conditions could be identified. The study does not cover the whole population but only a subset of the adult population. General demographic data was based on the published reports from 2013. The mean diabetes expenditure per individual was based on the IDF's Maltese specific cost, which was generated from multiple sources. However, this expenditure did not differentiate between newly diagnosed and previously diagnosed diabetes, as well as it was based on over-estimation of diabetes prevalence rate. The cost did not take in consideration intangible costs, which is difficult to quantify. The projections for 2045 were based on current conditions with the assumption that all demographic and risk factors would continue at their current rates.

Conclusion

Type 2 diabetes is an epidemic in Malta same as globally. The onset of newly diagnosed diabetes appears to affect females from the very young as the fourth decade of life irrespective of their geographical habitat. Furthermore, as the years progress, so do the estimated health expenditure contributed to this disease. This puts forward the recommendation that urgent preventive action is merited to tackle diabetes at a population level targeting the young generation. Such action would consequently reduce the health burden on the health care system and economy.

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