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Polypharmacy and Comorbidity Status in the Treatment of Type 2 Diabetic Patients Attending Tertiary Care Hospitals

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ABSTRACT

Aim: Diabetes is a lifelong disorder, which is markedly affected by day-to-day variations in diet, exercise, infection and stress. Hence, a thorough knowledge of the disease and how it alters normal body functions and the awareness of its acute and chronic complications is necessary. The present study thus tried to evaluate the comorbid conditions and concurrent medications associated with type 2 diabetic patients. It also aimed to address patient compliance for the medications provided to them. **Materials and Methods:** This was a cross-sectional observational study conducted for December 2023 to April 2024. Data were collected to determine the comorbidity and polypharmacy impact on patient with type 2 diabetes and also check the side effects, adverse drug reaction, other effects on patient, attending different local hospitals of Rawalpindi and Islamabad, Pakistan. **Results:** During the study period, 300 patients range from (15-80years). The majority were the females with (51%), and males were (49%). The mean of age and standard deviation taken from demographics 57.930 and 9.714, similarly mean and standard deviation of gender is 1.51 and 0.51 respectively. The age group less than 30 years is (2%) which is least effected. Age group 31-45 years (8%), 46-60 years is (44%), most effected age group is over 60 years with (46%). The present study evaluated that 86% of individuals with diabetes had at least one coexisting chronic condition. The findings of this study suggest that patients with diabetes who have multiple chronic conditions face a greater risk of polypharmacy the most common being Cardiovascular conditions (68%) and GIT diseases (54%). GI drugs were prescribed to 66% of the patients. The concurrent medications recommended included Alpha blockers (64%), NSAIDS (59%), Diuretics (35%), drugs for Antiepileptics (34%), and Antidepressants (8 %). **Conclusion:** The present study thus concluded that diabetic patients suffer from a number of comorbid conditions, most commonly, cardiovascular problems. The comorbidity increased with the age. The level of polypharmacy was also high, thereby increasing the pill burden for the patients.

1. INTRODUCTION

Diabetes mellitus (DM) is a group of metabolic disorder, resulting in hyperglycemia. It occurs due to lack of insulin hormone or insensitivity of cells to insulin, causing increased blood sugar level. There are two types of DM: type 1 caused by absolute insulin deficiency and type 2 caused by insulin resistance due to defective responsiveness of insulin receptors (1). Long-term damage of vital organs such as kidney, heart, nerves, blood vessels, and eyes results from chronic effect of diabetes (2). Diabetes is often initially managed by increasing exercise and dietary modification. As the condition progresses, medications may be needed. Unlike type 1 diabetes, there is very little tendency toward ketoacidosiss (3). though it is not unheard of One effect that can occur is non ketonic hyperglycemia. Long-term complications from high blood sugar can include increased risk of heart attacks, strokes, amputation, and kidney failure (4).

Diabetes mellitus (DM) is a group of chronic metabolic conditions, all of which are characterized by elevated

blood glucose levels resulting from the body's inability to produce insulin or resistance to insulin action, or both (5). Type 2, which develops when there is an abnormal increased resistance to the action of insulin and the body cannot produce enough insulin to overcome the resistance (6).

DM is associated with various comorbid conditions such as hypertension, hyperlipidemia, and cardiovascular disorders (7). Study of prescriptions of diabetic patients from various parts of the world suggests that antihypertensives, antihyperlipidemics, and antiplatelets are often coprescribed along with the antidiabetics (8). Hypertension or elevated blood arterial pressure affects about 70% of diabetic patients and the risk of development of hypertension is twice for diabetic patients compared to euglycemic individuals (9).

Hypertension is common among patients with type 2 diabetes, with a prevalence approximately twice that of the nondiabetic population, and may precede the onset of diabetes (10). The prevalence of hypertension is further increased in patients with type 2 diabetes mellitus and elevated AER, compared with patients with type 2 diabetes mellitus and no evidence of renal involvement. (11). The higher the systolic blood pressure, the greater the absolute excess cardiovascular risk for diabetic patients, indicating a greater potential for preventing cardiovascular death by control of elevated blood pressure (12). Ageing of the population and an increasing prevalence of obesity and sedentary life habits are leading to a greater prevalence of diabetes, particularly in Asia. (13). Because of the adverse impact of microalbuminuria (MA) on survival in patients with type 2 diabetes mellitus and the renal risk of macroalbuminuria, screening and intervention programs should be implemented early, at the stage of microalbuminuria (14). Annual screening for microalbuminuria is recommended by the American Diabetes Association (ADA), as a high proportion of patients with type 2 diabetes are found to have MAU or overt nephropathy shortly after diagnosis of their diabetes (15).

Thus, prescription studies from all around the world suggested that a diabetic patient is burdened with a number of medicines (16). Polypharmacy, that is, the use of multiple medicines by a single patient, is an integral part of diabetic patients (17). Studies in various parts of the world report that polypharmacy is becoming prevalent in therapy, especially among older adults (18). The specific number of drugs taken is not itself indicative of polypharmacy as all of the drugs may be clinically necessary and appropriate for the patient; however, as the number of prescribed drugs increases, so do the chances of polypharmacy (19). A 2002 national survey indicated that 25% of the overall population takes 5 or more medications per week (20). When specifically considering the population 65 years of age and older, this percentage increases to about 50%, with 44% of men and 57% of women taking 5 or more medications per week and 12% of both sexes taking 10 or more prescriptions per week. (21). Multiple drug therapy is apparently beneficial but with advancement of science, it is important to evaluate its burden and real effectiveness (22). The present study tried to estimate the correlation of polypharmacy with comorbidity in diabetic patients. This study also addressed the lifestyle and compliance of the diabetic patients. However, very few studies are known, that encompasses so many factors related to diabetes. Therefore, it justified the rationality and importance of the present study in global aspect.

2 METHODOLOGY

2.1. Study design

The study design involves carrying out a prescription-based study to determine the comorbidity and polypharmacy impact on patient with type 2 diabetes and also check the side effects, adverse drug reaction, other effects on patient in tertiary care hospitals. We compiled the data by taking prescription of different drugs used by diabetic patient attending in tertiary care hospitals.

2.2. Sample source

The sample of prescriptions was taken from tertiary care hospitals present in twin cities.

A total of 300 prescriptions were obtained from hospitals approved by the hospital authority.

The target of the papulation is the patients admitted to the hospital with type 2 diabetes using different anti diabetic drugs and have multiple diseases. And different drugs used by the diabetic patient was observed.

The study will be conducted upon the basis of random surveys in different local hospitals of Rawalpindi and Islamabad for example:

- Fauji Foundation Hospital, Rawalpindi.
- Quaid-e-Azam International Hospital, Islamabad.
- Hearts International Hospital, Rawalpindi.
- Holy Family Hospital, Rawalpindi.
- Benazir Bhutto Hospital, Rawalpindi.
- Bilal Hospital, Rawalpindi.
- Shifa International Hospital, Islamabad.

2.3. Time frame

These studies will be carried out from December 2023 to April 2024. These time frame allow us to observe the different parameters and to collect a comprehensive set of data.

2.4. Inclusion criteria

- Patients with type 2 diabetes either male or female.
- Patients with age of 20 to 70 are included.
- Patients on medications or not on medication.
- Patients with other diseases.
- Obesity.

2.5. Exclusion criteria

- Patients of age above 70.
- Hormonal Imbalance.
- Women who are pregnant or breast feeding.

2.6. Data collection

The prescriptions of patients with type 2 diabetes in tertiary care hospitals are gathered and compiled.

In data collection phase of study, a comprehensive set of information has been gathered from tertiary care Hospital in twin cities using multifaceted approach. The source of data collection is patient assessment, prescription records,

and Lab

2.7. Data analysis

Data was entered into the excel or documentation and interpretations of results. Or the organization and analysis of data SPSS was used. Each correct answer to the knowledge questions contributes one unit to the total score and the total score was converted into percentage the practice of each response regarding three main parameters mild, moderate severe

2.8. Ethical approval

The University of Lahore ethical review board will be granted ethical approval for this cross- sectional observational study. Before we started collecting information, we asked each person for their permission. Joining the study was completely optional, and nobody got paid or received any reward. We made sure to keep everyone's information private. We told each person what the survey was about and that we would only use the questionnaire if they agreed to fill it out and share their answers.

3. RESULTS

3.1. Demographics

The study included 300 diabetic patients range from (15-80years). The majority were the females with (51%), and males were (49%).

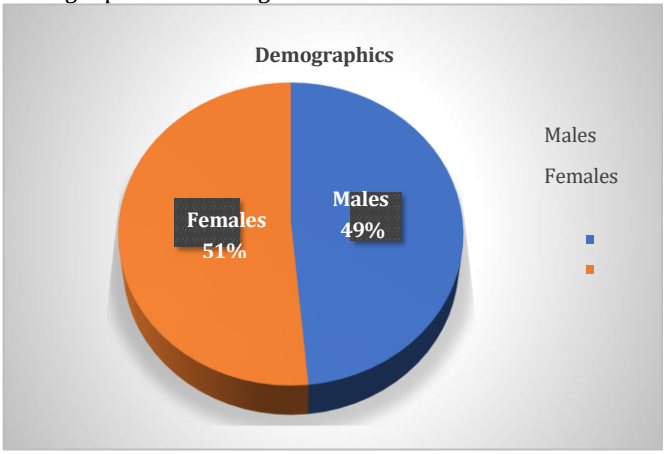
Table 1

Frequency distribution of demographics

Gender	Frequency of Cases	Percentage %
Male	148	49%
Female	152	51%

Figure 1

Demographics basis on gender



(Percentage of Diabetic Patient on the basis of Gender)

Table 2

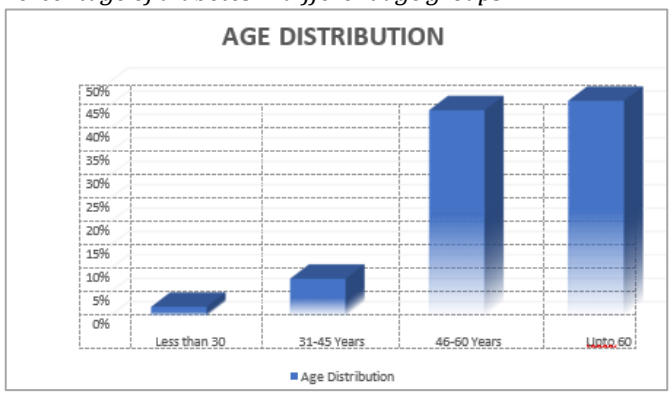
Mean and standard deviation of N papulation

FACTORS	AGE	GENDER
VALID N	300	300
MEAN	57.93	1.51
STANDARD DEVIATION	9.714	0.51

The mean of age and standard deviation taken from demographics 57.930 and 9.714, similarly mean and standard deviation of gender is 1.51 and 0.51 respectively

Figure 2

Percentage of diabetes in different age groups

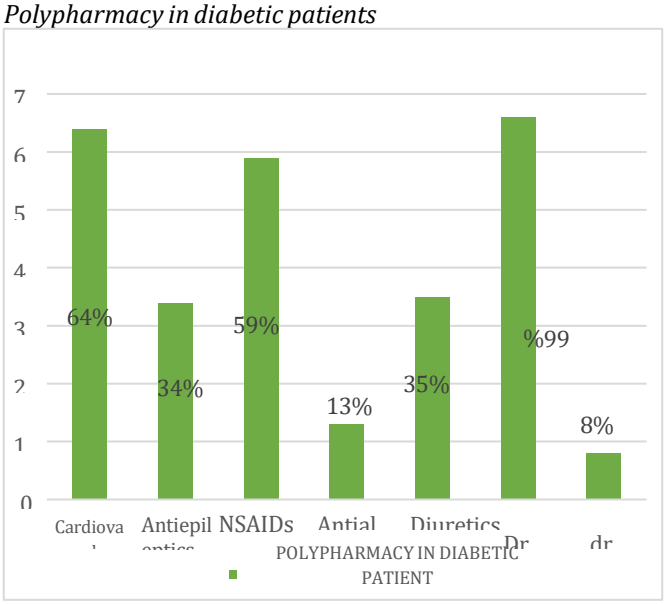


Percentage of diabetes in different age groups

Age distribution chart shows us the percentages of different age groups having diabetes. The age group less than 30 years is (2%) which is least effected. Age group 31-45 years (8%), 46-60 years is (44%), most effected age group is over 60 years with (46%).

Figure 3

Polypharmacy in diabetic patients



(Percentage of polypharmacy in diabetic patients)

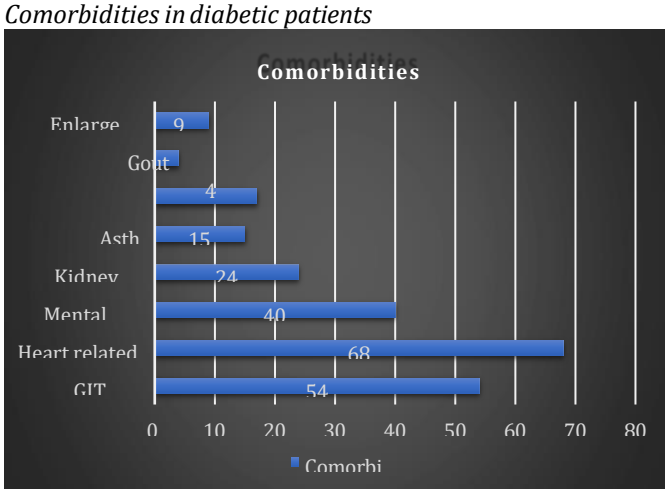
Table 3

Association of therapeutic class with polypharmacy, frequency, percentage and P. value

Therapeutic class		Polypharmacy Value > 5 Yes Value < 5 No	Frequency	Percentage	P. value
Antiepileptics	YES	48	102	34%	
	NO	54	198	66%	<.001
NSAIDS	YES	81	177	59%	
	NO	96	123	41%	.004
Diuretics	YES	48	105	35%	
	NO	57	195	65%	.594
Alpha blockers	YES	93	192	64%	
	NO	99	108	36%	.583
Antidepressants	YES	12	24	8%	
	NO	12	276	92%	<.001
GI drugs	YES	102	198	66%	
	NO	96	102	34%	<.001

Figure 4

Comorbidities in diabetic patients



Percentage of comorbidities in diabetic Patients

Table 4

Comorbidities and their percentages, frequency and P. value

	Percentage N	Frequency	P. value
Total	100%	300	
Kidney Diseases		.347	
Yes	24	72	
No	76	228	
Arthritis		.572	
Yes	17	51	
No	83	249	
Mental disorder		<.001	
Yes	40	120	
No	60	180	
Cardiovascular conditions		.280	
Yes	68	204	
No	32	96	
Gout		.070	
Yes	4	12	
No	96	228	
GIT diseases		<.001	
Yes	54	162	
No	46	138	
Respiratory problems		.560	
Yes	17	45	
No	83	255	
Enlarge prostate		.002	
Yes	9	27	
No	91	91	

Table 5

Association of Age and Gender with Comorbidities

	Comorbidities value > 3	Percentage N	Frequency
Total		100%	300
Age group			
15-30	0	1	3
31-45	3	9	27
45-60	57	46	138
Up to 60	66	44	132
Gender			
Male	54	49	148
Female	72	51	152

4. DISCUSSION

Our study was set out to examine the prevalence of polypharmacy and comorbidities among adults with diabetes in Twin cities. In our sample of subjects with diabetes, the rate of polypharmacy was high, as nearly three out of five adults with diabetes were prescribed five or more medications (23). Similar rates were reported in the literature among patients with diabetes 54%–84%, however, to our knowledge, no study has attempted to measure the rate of polypharmacy among all age groups of adults with diabetes, which is a major contribution of our study (24). A higher rate of polypharmacy among older patients (age 50 and above) as compared with younger age groups was also observed in this study. Studies among adults in the general population have reported that older adults (age ≥ 50 or age ≥ 60 years) have a higher risk of polypharmacy use as compared with adults. One possible explanation for the high prevalence of polypharmacy in this population is the presence of multiple chronic conditions. (25)

Moreover, a significant finding of our study is the high prevalence of chronic conditions and the high rates of polypharmacy within diabetic individuals with presence of chronic conditions (26). Prior studies have demonstrated that 90% of patients with diabetes have at least one accompanying chronic condition, our study discovered that 86% of individuals with diabetes had at least one coexisting chronic condition (27). It is reasonable to suggest that the high prevalence of polypharmacy in this study may be linked to the number of comorbidities within the study population (28). The findings of this study suggest that patients with diabetes who have multiple chronic conditions face a greater risk of polypharmacy. Even though there is a substantial body of literature detailing the connection between a higher number of coexisting conditions and polypharmacy, our study extended the literature by analyzing the alliance between the type of chronic conditions and polypharmacy (29).

We found that the polypharmacy rates varied by the type of coexisting chronic conditions; with the highest use among those with cardiovascular and musculoskeletal conditions (30). This is not unexpected because patients with musculoskeletal conditions, including osteoarthritis, typically use analgesics and NSAIDs to relieve chronic pain (31). We also found that individuals with cluster of diseases (diabetes and cardiovascular diseases) have a higher rate of polypharmacy as compared with adults without the cluster of diseases (32). Patients with diabetes and mental health conditions also demonstrate a higher rate of polypharmacy compared to those without mental health conditions. Additionally, research is necessary to identify the contributing factors, as there is a lack of supporting evidence in the literature (33). Further, polypharmacy is significantly common among patients with diabetes and respiratory diseases, which is consistent with findings from earlier studies that reported increased medication use in patients with COPD (34).

Consequently, healthcare providers must routinely assess these individuals for potentially inappropriate medications, adverse drug events, and drug-drug interactions. For instance, comprehensive geriatric assessments have proven effective in reducing the number of medications prescribed to older adults (35).

Patients with diabetes who are on multiple medications may benefit from a multidisciplinary

collaborative care model that includes pharmacist follow-up to evaluate their medication use and reduce the risks associated with polypharmacy (36).

In a randomized, controlled study with an open-label, parallel-arm design, collaborative care has been linked to improvements in diabetes management and a reduction in healthcare costs (37). Pharmacists can assist other healthcare providers in identifying polypharmacy, recognizing drug interactions, and offering recommendations for simplified medication regimens, thereby minimizing the number of medications and positively influencing health outcomes in diabetes care. (38).

We also examined other factors related to polypharmacy and found that women were more likely to experience it compared to men, which is consistent with findings from studies involving

patients with diabetes. Additionally, research has shown that women in the general population tend to use both prescribed and non-prescribed medications more frequently and have higher healthcare utilization than men (39). This may be due to women being more proactive about their health and seeking healthcare services more often than men. It is important to note that the majority of diabetes patients in our study were women, which is not surprising given that the incidence of diabetes is higher in women than in men in twin cities.

5. CONCLUSION

Polypharmacy is quite common among adults with diabetes, especially in those who have multiple chronic conditions. Older adults are particularly affected, likely due to a greater number of chronic health issues in this demographic. Furthermore, individuals with coexisting cardiovascular, mental, and musculoskeletal conditions face a higher risk of polypharmacy. Simplifying treatment regimens for those with diabetes may enhance health outcomes for this group.

REFERENCES

1. Agborsangaya, C. B., Lau, D., Lahtinen, M., Cooke, T., & Johnson, J. A. (2012). Health-related quality of life and healthcare utilization in multimorbidity: Results of a cross-sectional survey. *Quality of Life Research*, *22*(4), 791-799. https://doi.org/10.1007/s11136-012-0214-7
2. Alarcon, T. (1999). Factors predictive of outcome on admission to an acute geriatric ward. *Age and Ageing*, *28*(5), 429-432. https://doi.org/10.1093/ageing/28.5.429
3. Al-Nozha, M. M., Al-Maatouq, M. A., Al-Mazrou, Y. Y., & Al-Harthi, S. S. (2004). Diabetes mellitus in saudi arabia.
4. Austin, R. P. (2006). Polypharmacy as a risk factor in the treatment of type 2 diabetes. *Diabetes Spectrum*, *19*(1), 13-16. https://doi.org/10.2337/diaspect.19.1.13
5. Boccuzzi, S. J., Wogen, J., Fox, J., Sung, J. C., Shah, A. B., & Kim, J. (2001). Utilization of oral hypoglycemic agents in a drug-insured US population. *Diabetes care*, *24*(8), 1411-1415. https://doi.org/10.2337/diacare.24.8.1411
6. Buysschaert, M., & Bergman, M. (2011). Definition of prediabetes. *Medical Clinics of North America*, *95*(2), 289-297. https://doi.org/10.1016/j.mcna.2010.11.002
7. Canivell, S., & Gomis, R. (2014). Diagnosis and classification of autoimmune diabetes mellitus. *Autoimmunity Reviews*, *13*(4-5), 403-407. https://doi.org/10.1016/j.autrev.2014.01.020
8. Cohen, J. A., Jeffers, B. W., Faldut, D., Marcoux, M., & Schrier, R. W. (1998). Risks for sensorimotor peripheral neuropathy and autonomic neuropathy in non-insulin-dependent diabetes mellitus (NIDDM). *Muscle & Nerve*, *21*(1), 72-80. https://doi.org/10.1002/(sici)1097-4598(199801)21:1<72::aid-mus10>3.3.co;2-p
9. de Zeeuw, D., Remuzzi, G., Parving, H., Keane, W. F., Zhang, Z., Shahinfar, S., Snapinn, S., Cooper, M. E., Mitch, W. E., & Brenner, B. M. (2004). Proteinuria, a target for renoprotection in patients with type 2 diabetic nephropathy: Lessons from RENAAL. *Kidney International*, *65*(6), 2309-2320. https://doi.org/10.1111/j.1523-1755.2004.00653.x
10. Dinneen, S. F. (1997). The association of microalbuminuria and mortality in non—insulin-dependent diabetes mellitus. *Archives of Internal Medicine*, *157*(13), 1413. https://doi.org/10.1001/archinte.1997.00440340025002
11. Epstein, M., & Sowers, J. R. (1992). Diabetes mellitus and hypertension. *Hypertension*, *19*(5), 403-418. https://doi.org/10.1161/01.hyp.19.5.403
12. Filkova, M., Ibrahim, F., Norton, S., Scott, D., Mant, T., Cope, A., Molokhia, M., & Galloway, J. (2015). THU0079 Polypharmacy, although not combination Dmard therapy, in rheumatoid arthritis is associated with increased hospitalisation risk. *Annals of the Rheumatic Diseases*, *74*, 220-221. https://doi.org/10.1136/annrheumdis-2015-eular.3604
13. FRANKLIN, G. M., KAHN, L. B., BAXTER, J., MARSHALL, J. A., & HAMMAN, R. F. (1990). Sensory neuropathy in non-insulin-dependent diabetes mellitus. *American Journal of Epidemiology*, *131*(4), 633-643. https://doi.org/10.1093/oxfordjournals.aje.a115547
14. Galtier, F. (2010). Definition, epidemiology, risk factors. *Diabetes & Metabolism*, *36*(6), 628-651. https://doi.org/10.1016/j.diabet.2010.11.014
15. Gomes, E. R., & Demoly, P. (2005). Epidemiology of hypersensitivity drug reactions. *Current Opinion in Allergy & Clinical Immunology*, *5*(4), 309-316. https://doi.org/10.1097/01.all.0000173785.81024.33
16. Grant, R. W., Cagliero, E., Murphy-Sheehy, P., Singer, D. E., Nathan, D. M., & Meigs, J. B. (2002). Comparison of hyperglycemia, hypertension, and hypercholesterolemia management in patients with type 2 diabetes. *The American Journal of Medicine*, *112*(8), 603-609. https://doi.org/10.1016/s0002-9343(02)01103-8
17. Gregg, E. W., Gu, Q., Williams, D., De Rekeneire, N., Cheng, Y. J., Geiss, L., & Engelgau, M. (2007). Prevalence of lower extremity diseases associated with normal glucose levels, impaired fasting glucose, and diabetes among U.S. adults aged 40 or older. *Diabetes Research and Clinical Practice*, *77*(3), 485-488. https://doi.org/10.1016/j.diabres.2007.01.005
18. Gurwitz, J. H., Field, T. S., Harrold, L. R., Rothschild, J., Debellis, K., Seger, A. C., Cadoret, C., Fish, L. S., Garber, L., Kelleher, M., & Bates, D. W. (2003). Incidence and preventability of adverse drug events among older persons in the ambulatory setting. *JAMA*, *289*(9), 1107. https://doi.org/10.1001/jama.289.9.1107
19. Javanbakht, M., Abolhasani, F., Mashayekhi, A., & Baradaran, H. (2013). Health-related quality of life in patients with type 2 diabetes mellitus in Iran: A national survey. *Primary Care Diabetes*, *7*(1), 72. https://doi.org/10.1016/j.pcd.2012.10.046

20. Javanbakht, M., Abolhasani, F., Mashayekhi, A., Baradaran, H. R., & Jahangiri noudeh, Y. (2012). Health related quality of life in patients with type 2 diabetes mellitus in Iran: a national survey. https://doi.org/10.1371/journal.pone.0044526
21. Kaufman, D. W., Kelly, J. P., Rosenberg, L., Anderson, T. E., & Mitchell, A. A. (2002). Recent patterns of medication use in the ambulatory adult population of the United States. *JAMA*, *287*(3), 337. https://doi.org/10.1001/jama.287.3.337
22. Lebovitz, H. E. (1999). Type 2 diabetes: An overview. *Clinical Chemistry*, *45*(8), 1339-1345. https://doi.org/10.1093/clinchem/45.8.1339
23. Malkani, S., & Mordes, J. P. (2011). Implications of using hemoglobin A1C for diagnosing diabetes mellitus. *The American Journal of Medicine*, *124*(5), 395-401. https://doi.org/10.1016/j.amjmed.2010.11.025
24. Mather, H., Chaturvedi, N., & Kehely, A. (1998). Comparison of prevalence and risk factors for microalbuminuria in south asians and Europeans with type 2 diabetes mellitus. *Diabetic Medicine*, *15*(8), 672-677. https://doi.org/10.1002/(sici)1096-9136(199808)15:8<672::aid-dia648>3.0.co;2-3
25. McDonald, T. J., & Warren, R. (2014). Diagnostic confusion? Repeat HbA1c for the diagnosis of diabetes. *Diabetes Care*, *37*(6), e135-e136. https://doi.org/10.2337/dc14-0055
26. Miettinen, H., Haffner, S. M., Lehto, S., Rönnemaa, T., Pyörälä, K., & Laakso, M. (1996). Proteinuria predicts stroke and other atherosclerotic vascular disease events in nondiabetic and non–insulin-dependent diabetic subjects. *Stroke*, *27*(11), 2033-2039. https://doi.org/10.1161/01.str.27.11.2033
27. Néss, S., Midthjell, K., Moum, T., Sørensen, T., & Tambs, K. (1995). Diabetes mellitus and psychological well-being. Results of the nord-trøndelag health survey. *Scandinavian Journal of Social Medicine*, *23*(3), 179-188. https://doi.org/10.1177/140349489502300308
28. Nguyen, J. K., Fouts, M. M., Kotabe, S. E., & Lo, E. (2006). Polypharmacy as a risk factor for adverse drug reactions in geriatric nursing home residents. *The American Journal of Geriatric Pharmacotherapy*, *4*(1), 36-41. https://doi.org/10.1016/j.amjopharm.2006.03.002
29. O'Sullivan JB, Mahan CM. Criteria for the oral glucose tolerance test in pregnancy. *Diabetes.* 1964; 13:278–85.
30. Pablos-Méndez, A., Knirsch, C. A., Barr, R., Lerner, B. H., & Frieden, T. R. (1997). Nonadherence in tuberculosis treatment: Predictors and consequences in New York City. *The American Journal of Medicine*, *102*(2), 164-170. https://doi.org/10.1016/s0002-9343(96)00402-0
31. Peron, E. P., Ogbonna, K. C., & Donohoe, K. L. (2015). Antidiabetic medications and polypharmacy. *Clinics in Geriatric Medicine*, *31*(1), 17-27. https://doi.org/10.1016/j.cger.2014.08.017
32. Roglic, G., & Colagiuri, S. (2014). Gestational diabetes mellitus: Squaring the circle. *Diabetes Care*, *37*(6), e143-e144. https://doi.org/10.2337/dc14-0344
33. Rollason, V., & Vogt, N. (2003). Reduction of polypharmacy in the elderly. *Drugs & Aging*, *20*(11), 817-832. https://doi.org/10.2165/00002512-200320110-00003
34. Sacks, D. B., Arnold, M., Bakris, G. L., Bruns, D. E., Horvath, A. R., Lernmark, Å., Metzger, B. E., Nathan, D. M., & Kirkman, M. S. (2023). Guidelines and recommendations for laboratory analysis in the diagnosis and management of diabetes mellitus. https://doi.org/10.2337/figshare.23519148.v1
35. Shaw, J. E., D'Emden, M. C., & Goodall, I. (2011). Is Australia ready to use glycated haemoglobin for the diagnosis of diabetes? *Medical Journal of Australia*, *195*(1), 7-8. https://doi.org/10.5694/j.1326-5377.2011.tb03178.x
36. Stocks, S. J., Kontopantelis, E., Akbarov, A., Rodgers, S., Avery, A. J., & Ashcroft, D. M. (2015). Examining variations in prescribing safety in UK general practice: Cross sectional study using the clinical practice research Datalink. *BMJ*, h5501. https://doi.org/10.1136/bmj.h5501
37. Stone, M. A., Camosso-Stefinovic, J., Wilkinson, J., De Lusignan, S., Hattersley, A. T., & Khunti, K. (2010). Incorrect and incomplete coding and classification of diabetes: A systematic review. *Diabetic Medicine*, *27*(5), 491-497. https://doi.org/10.1111/j.1464-5491.2009.02920.x
38. Tiihonen, J. (2012). Polypharmacy with antipsychotics, antidepressants, or benzodiazepines and mortality in schizophrenia. *Archives of General Psychiatry*, *69*(5), 476. https://doi.org/10.1001/archgenpsychiatry.2011.1532
39. Toobert, D. J., Hampson, S. E., & Glasgow, R. E. (2000). The summary of diabetes self-care activities measure: Results from 7 studies and a revised scale. *Diabetes Care*, *23*(7), 943-950. https://doi.org/10.2337/diacare.23.7.943