Diabetes Mellitus in German Primary Care: Quality of Glycaemic Control and Subpopulations not well Controlled – Results of the DETECT Study

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Abstract

Introduction: The quality of glycaemic control of patients with T1D and T2D can be assessed with HbA_{1c} levels. We aimed to assess the quality of glycaemic control and the prevalence of inadequately controlled diabetes in German primary care, and to determine simple patient and treatment related factors associated with poor control.

Material and Methods: Using a nationwide probability sample of 3188 general practices (response rate 50.6%), a total of 55,518 patients were assessed in DETECT, a cross-sectional and prospective multistage epidemiological study. Diabetes diagnoses were based on physician assessment. HbA_{1c} values were taken from the patient charts.

Results: The quality of metabolic control was unsatisfactory on the whole in the 277 people with T1D (e.g. mean HbA_{1c}=7.4%±1.4%). The 8188 people with T2D had a mean HbA_{1c} of 6.89%±1.2%. 38.8% of individuals had an $HbA_{1c} \geq 7.0\%$. The situation was less favourable in subjects with a longer history of diabetes – in many cases in those with diabetes for 5–9 years, but generally in those with a plus-10-year history of diabetes – and also in younger men with a shorter disease history. Patients with a short T2D history, especially older subjects had more favourable values. With regard to age, a higher percentage of patients had an $HbA_{1c} \geq 7.0\%$ (42.0% and 40.6%) in the 45–54 and 55–64 year olds. With respect to the correlation between HbA_{1c} and treatment modality, we identified the best metabolic control in T2D patients without drug therapy for diabetes, and the worst in patients on combination regimens (OAD/insulin). The average duration of diabetes in the various treatment groups differs substantially. The average duration was highest (12.1 y) in the insulin group. Oral treatment was the predominant treatment modality in all HbA_{1c} categories.

Conclusion: T1D treatment needs to be improved overall. The situation as regards T2D is less clear-cut. When people with T2D start requiring more intensive and complex treatment in response to disease progression, the treatment efforts of patients and physicians evidently fail to keep up with the actual pace of metabolic deterioration. Early and strict alignment with approximately normal HbA_{1c} targets is essential. Close attention should be paid to T2 diabetics with a 5–9-year diabetes history, with the aim of preventing any loss of metabolic control. Likewise, patients aged 45–64 y and younger men require more attention.

Introduction

Improved recognition, diagnosis and treatment of risk factors for micro- and macrovascular diseases and complications such as diabetes mellitus, hypertension and dyslipidaemia, should be among the top priorities of any healthcare system. Looking at the German situation in particular, we need more insight into the prevalence and nature of these risk factors in routine medical care. Transparency remains poor overall. Patients are mainly treated by their primary care physician. As such, primary care is essential to improving the health status of individual patients and of the German population in general. A more thorough knowledge on clinical outcomes in primary care as a basis for identifying patients at risk of cardiovascular complications is needed.

DETECT (Diabetes Cardiovascular Risk-Evaluation: Targets and Essential Data for Commitment of Treatment), a large-scale, nationally representative epidemiological study in German pri-

mary care has the following objectives: to determine (1) the prevalence of cardiovascular risk factors, (2) frequency in subgroups and (3) combination of risk factors in primary care patients, and (4) the degree of met and unmet medical needs in this population (Wittchen et al., 2005; Stojakovic et al., 2005; Böhler et al., 2004).

It is well documented, both for patients with type 2 diabetes (T2D, DM type 2) and for subjects with type 1 diabetes (T1D, DM type 1), that the onset of micro- and macrovascular comorbidities and complications depends to a crucial extent on the quality of diabetes control (among other factors) (Stratton et al., 2000; DCCT writing team, 2002; Cleary et al., 2006). Recent guidelines from the American Diabetes Association (ADA, 2007) and the International Diabetes Federation (IDF, 2005) state the applicability of HbA_{1c} as a measure of the quality of long-term glycaemic control. A number of studies investigating the quality of diabetes control as reflected in patients' HbA_{1c} values are now available for Germany. Examples include KORA (Rathmann and Giani, 2003; Icks et al., 2006), evaluations of data acquired in connection with diabetes care structure agreements and disease management programmes (DMPs) in Saxony, North Rhine-Westphalia, etc. (Altenhofen et al., 2002; Schulze et al., 2003) and other sources (Sämann et al., 2006). However, most of these datasets pertain to individual regions. Only a few publications consider the situation in primary care nationwide (Lehnert et al., 2005; Pittrow et al., 2006). The database for Germany as a whole is as yet unsatisfactory.

The aim of DETECT is to acquire nationwide representative data for primary care in Germany. The main study was designed in the format of a nationwide prospective survey with a cutoff date [2003], and provides valuable and profound insights into the state of health and care of patients in primary care on the survey date. This paper reports the results of the point prevalence survey. The objectives are:

- To provide information on the current quality of glycaemic control of people with diabetes in primary care (due to their clear numerical superiority, the main focus is on type 2 diabetic patients);
- To explore associations between quality of control and key parameters such as gender, age, duration of diabetes, and treatment modality; and finally
- To identify patient subpopulations – in terms of gender, age and duration of diabetes – with inadequate metabolic control in real-life clinical settings, who are likely to have a correspondingly higher risk of developing micro- and macrovascular comorbidities and complications.

Material and Methods

DETECT is a three-stage, cross-sectional clinical epidemiological study with a prospective-longitudinal component in German primary care, consisting of:

- A provider (pre-study) survey in a nationally representative sample of primary care physicians in Germany. The applied questionnaire intended to obtain basic information on human resources and structural characteristics of doctors' practices as well as qualifications and attitudes related to diagnosis and care of patients [2003].
- A cross-sectional point prevalence study (main stage) involving 55,518 unselected consecutive patients. All patients signed an informed consent form, completed a self report patient's questionnaire and a structured clinical interview and examination. A random sub sample (n=7519) participated in a broad standardized screening work-up [2003];
- A prospective and longitudinal cohort study based on patients from the random laboratory sub sample of stage II [running until end of 2007].

This paper is based on data from stage II of DETECT. Initially, before stage I, 7053 eligible primary care physicians were randomly selected from a pool of 64,707 primary care physicians. Not all could be recruited in stage I, for various reasons. 3795 primary care physicians participated in total. 3188 (84.2%) of them joined part II. More details of the study and its approach are published extensively elsewhere (Wittchen et al., 2005; Stojakovic et al., 2005; Böhler et al., 2004; Lehnert et al., 2005; Pittrow et al., 2006).

The diagnosis diabetes mellitus and the DM type were assigned by physician assessments (no borderline or uncertain cases). In cases where the type of diabetes were not stated, this information was supplemented by particulars from later questionnaires in patients who also took part in follow-up (for the longitudinal part of DETECT). In addition, patients receiving insulin and were <35 years of age, or received insulin prior to age 35, were assigned to the type I category. All other patients receiving diabetes medication whose diagnosis was not stated by their physician were assigned to type 2. The data was then reviewed to ascertain whether assignation of patients to type 1 or type 2 diabetes was plausible on the basis of the available data (duration of disease, medication, body mass index).

In this paper, key parameters used to describe the quality of HbA_{1c} control are

- mean HbA_{1c} and
- frequency of patients with an HbA_{1c} reading above the cutoff value of 7.0% for type 1 (ADA, 2007; Scherbaum et al., 2003) and type 2 diabetes (ADA, 2007; NVL 2002), i.e. individuals with a reading indicating a need for intensified therapy.

The DETECT survey received the approval of the Ethics Committee of the Carl Gustav Carus Medical Faculty at the Technical University of Dresden (AZ: EK149092003; Date: 16.09.2003). Informed consent was obtained from all patients. Analyses were descriptive. Statistical analyses were conducted using Stata Statistical Software 9.2 (StataCorp, 2006). Standard errors were adjusted for within-practice clustering of observations (patients) by applying the Huber-White sandwich matrix (Royall, 1986). The association of HbA_{1c} with age and duration of disease was estimated by nonparametric kernel regression (Gasser and Müller, 1979) using the epanechnikov kernel and a bandwidth of 10. The association of HbA_{1c} and dichotomous treatment modalities were visualized by applying generalized additive models (Hastie and Tibshirani, 1987).

Results

Survey population

15.2% of the adults (over 18 years) reported in the cross-sectional part of DETECT were identified as people with diabetes. Out of the total study population of 55,518 adults, 8465 people were classified by their primary care physician as having diabetes.

The diabetic population was divided into 277 with DM type 1 (50.5% female, having a lower mean age [43.2 years] and a longer average duration of diabetes [20.8 years], representing 0.5% of the total study population); and in 8188 with DM type 2 (51.3%

female, having a higher mean age [66.3 years] and an average diabetes duration of 7.8 years, representing 14.7% of the total study population). As was to be expected, patients with T1D were only treated with insulin. The majority of patients with T2D were treated according to a stepwise treatment plan as proposed in the 2002 German national treatment guidelines for DM type 2 (NVL T2D: **N**ationale **V**ersorgungs**l**eitlinie T2D) and other guidelines. The mean age and average duration of diabetes in the various treatment groups (no treatment, diet & exercise, oral treatment, tablets & insulin, insulin) fit very well to a stepwise treatment algorithm. For 762 patients with T2D, the type of glucose lowering treatment was not given. For 507, it was "no treatment"; for 1017, "diet & exercise". "OAD" (oral anti diabetic drug(s)) was stated for 3700, "OAD & insulin" for 942, and "insulin" for 1260 patients. For the purpose of this paper, patients with "no treatment" and patients with "diet & exercise" are combined in a single "no glucose lowering drug" group; see **Table 1** and **Fig. 4**. **Table 1** presents more details on the basic characteristics of the survey population.

It is important to remember that, in patients with T2D, treatment modalities are not mere descriptions of the therapy administered to patients; the type of treatment also correlates to some extent with the severity of the diabetes.

Whereas in the T1D population, the men were somewhat older than the women (mean age of 44.5 y vs. 41.9 y, p = 0.133) and had a somewhat longer diabetes history (mean diabetes history 21.6 y vs. 20.1 y, p = 0.342), the opposite applies in the T2D population (mean age of 65.3 y for men vs. 67.3 y for women, p = 0.000; mean diabetes history 7.6 y vs 8.1 y, p = 0.000). This gender-specific phenomenon applies to a varying degree for all treatment modalities in T2D (**Table 1**).

HbA_{1c} – age and duration of diabetes

An HbA_{1c} reading is reported for 220 adults with a diagnosis of **DM type 1** (see **Table 2**. In **Tables 2, 3** the overall reading is indicated in italics and values above the overall reading are shown in bold).

The mean HbA_{1c} was 7.4 ± 1.4%; 7.5 ± 1.4% (n = 113) in men and 7.4 ± 1.3% (n = 107) in women. The percentage of persons with a HbA_{1c} of ≥ 7.0% was 58.2%, with a higher prevalence in men (60.2%) and a slightly lower prevalence in the female TD1 population: 56.1%. Men in the 18–34 age group had a high average HbA_{1c} of 7.9%, and a high proportion of insufficiently controlled HbA_{1c}: 70.0%. Women in the 65–74 age group likewise: 8.0% and 75.0%, respectively. The lowest mean haemoglobin A_{1c} (7.1%) was found in men in the 35–44 age group. The corresponding figure in the female 18–34 and 35–45 age groups was 7.2%. The lowest percentage of individuals with poor control (45.5%) was seen in the 65–74 age groups in men and in the 35–55 age group in women (45.8%). With respect to the reported "duration of diabetes", men with a diabetes history of 5–9 y had the highest average haemoglobin A_{1c} (8.1%). In the female population, the highest average HbA_{1c} (7.7%) was in subjects with a disease history of 25 y and longer. In the male population, the prevalence of HbA_{1c} ≥ 7.0% was lowest (50.0%) in the 15–19 y category. In the female population, the category with the lowest prevalence (38.5%) was 0–4 y.

A more complex map of HbA_{1c} readings was found in adults with a diagnosis of **DM type 2.** Data are available from 8188 people, which allows more specific analyses for T2D. **Table 3** and **Fig. 1** show the proportions of patients with a HbA_{1c} of ≥ 7.0% in the DETECT population of people with T2D and in subpopulations classified by gender, age and duration of diabetes. **Figs. 2, 3** show the associations between (mean) haemoglobin A_{1c} and the reported age/duration of diabetes.

The overall mean HbA_{1c} was 6.89% ± 1.2% (n = 6891). Men (n = 3359) and women (n = 3532) did not differ. The overall percentage of individuals with an HbA_{1c} ≥ 7.0% was 38.8%. The prevalence in men was slightly better than in women (37.8% vs. 39.8%).

Table 3 and **Fig. 1** show a clear picture: All subgroups of individuals affected by T2D, in all age groups, with a diabetes history of 10 years and longer had proportions of patients with insufficiently controlled diabetes above the overall percentage, in most cases above 50%. In these subgroups, roughly every second patient was insufficiently controlled (based on a threshold haemoglobin A_{1c} of 7.0%). In these patients with a diabetes history ≥ 10 y, the average HbA_{1c} was 7.15%; this is above the overall mean as well. In "younger" women with a longer history of diabetes - see **Table 3** - we find prevalences of individuals with HbA_{1c} ≥ 7.0% of up to 100%. In these subgroups of "younger" women with a longer diabetes history, the average HbA_{1c} in most cases exceeded 8.0%.

Table 3 shows that, in addition to subpopulations with a disease history of ≥ 10 y, insufficiently controlled T2D (HbA_{1c} ≥ 7.0%) was relatively often found in men aged 18–34 y with a diabetes duration of up to 4 y (only a limited number of persons), men aged 35–64 y, and women aged 45–74 y, in each case with a diabetes history of 5–9 y. Again, the average HbA_{1c} followed the trend and was higher as well, ranging in these subpopulations from 7.0% to 7.6% (the latter in men aged 18–34 with a diabetes history of 0–4 y).

With respect to the age groups of T2 diabetics in DETECT, the 45–54 and 54–64 year olds stand out in terms of glycaemic metabolic control. We found the highest prevalences of haemoglobin A_{1c} ≥ 7.0% (42.0% and 40.6%, prevalence odds ratio vs. all other age classes 1.2, 95% confidence interval: 1.04–1.3) and highest mean HbA_{1c} readings (7.1% and 7.0%) in these age groups (Mean HbA_{1c}: 6.9% for age groups 18–34 y, 35–44 y and 65–74 y; 6.8% for age group ≥ 75 y).

In T2D the HbA_{1c} rises in response to the duration of diabetes in the DETECT population. The mean value was 6.7% in T2 diabetics with a disease history of 0–4 y, 6.9% for a disease history of 5–9y, 7.1% for 10–14 y, 7.1% for 15–19 y, 7.3% for 20–24 y, and 7.2% for ≥ 25 y.

Fig. 2 shows the trend for all T2 diabetic patients and for the two genders separately. The T2D population showed a moderate and steady rise during the first decade of disease in the average haemoglobin A_{1c} estimated from the sample for the total population. With a duration of diabetes of approximately 10 years, the curves for men and women become disparate, with the latter curve displaying a steeper gradient. The rise is somewhat more marked between year 10 and year 15, approximately, but subsequently flattens, especially for the men studied in DETECT. Univariate analysis per year disclosed a progression of HbA_{1c} of an average of 0.08% points in arithmetic terms. The progression was somewhat greater in women (0.09% points) and less in men (0.07% points) (p of 0.000 in either case).

In arithmetic terms, there is a slight average decline per year of age, the mean being 0.004% points (p = 0.004). In men, the decline is 0.006% points (p = 0.009); in women, it is 0.003% points (p = 0.127). The curve in **Fig. 3** shows a metabolic control level with much higher mean HbA_{1c} values for younger men than for younger women. The inverse situation applies from an

Table 1 Basic data – survey population

	Total study population (n = 55,518)		Patients without diabetes (n = 47,053)		Patients with diabetes (N = 8 465)													
					Patients with T1D (n = 277)		Patients with T2D (n = 8188)		Patients with type 2 diabetes by treatment modality									
									No glucose lowering drugs (n = 1524)		OAD (n = 3700)		OAD & insulin (n = 942)		Insulin (n = 1260)		No data on treatment (n = 762)	
Gender	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
male	22,679	40.9	18,552	39.4	137	49.5	3990	48.7	721	47.3	1884	50.9	422	44.8	616	48.9	347	45.5
female	32,839	59.2	28,501	60.6	140	50.5	4198	51.3	803	52.7	1816	49.1	520	55.2	644	51.1	415	54.5
	mean	SD	mean	SD	mean	SD	mean	SD	mean	SD	mean	SD	mean	SD	mean	SD	mean	SD
Age (years)	53.9	17.3	51.8	17.3	43.2	14.2	66.3	10.6	66.9	10.9	66.5	10.3	66.1	10.0	65.7	10.6	65.4	11.9
male	54.6	16.8	52.4	17.0	44.5	14.3	65.3	10.1	65.8	10.3	65.5	9.9	65.0	10.0	64.5	9.9	64.6	10.9
female	53.4	17.7	51.4	17.5	41.9	14.0	67.3	10.1	67.9	11.3	67.6	10.6	67.0	9.9	66.8	11.0	66.1	12.5
Duration of diabetes (years)	–	–	–	–	20.8	13.2	7.8	6.8	5.0	5.1	7.0	5.9	11.5	7.2	12.1	8.1	5.4	5.6
male	–	–	–	–	21.6	13.5	7.6	6.6	4.8	5.0	6.9	5.8	10.7	6.7	11.6	7.8	5.5	5.5
female	–	–	–	–	20.1	12.9	8.1	7.0	5.2	5.1	7.1	5.9	12.1	7.6	12.6	8.3	5.3	5.6
HbA_{1c} (%)*	–	–	5.6	0.7	7.4	1.4	6.9	1.2	6.2	0.8	6.9	1.2	7.5	1.3	7.3	1.4	6.4	1.0
male	–	–	5.6	0.7	7.5	1.4	6.9	1.2	6.2	0.8	6.9	1.2	7.5	1.3	7.2	1.4	6.5	1.0
female	–	–	5.6	0.7	7.4	1.3	6.9	1.2	6.2	0.8	6.9	1.1	7.6	1.2	7.4	1.3	6.3	0.9
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
$HbA_{1c} \geq 7\%$*	–	–	–	–	128	58.2	2673	38.8	153	12.4	1288	39.6	548	63.4	607	54.9	77	17.7
male	–	–	–	–	68	60.2	1269	37.8	77	13.0	645	39.0	236	60.8	274	50.9	37	19.9
female	–	–	–	–	60	56.1	1404	39.8	76	11.9	643	40.2	312	65.4	333	58.7	40	16.1

*patients without diabetes: HbA_{1c} reported for 3 718 pats.; patients with diabetes: HbA_{1c} reported for 7 111 pats. / T1D: for 220 pats. T2D: for 6 891 pats.

Table 2 Type 1 diabetes – mean HbA1c and proportion of patients with HbA1c ≥ 7.0 % by gender, age and duration of diabetes

	Patients with type 1 diabetes								
	Total			Male			Female		
	n	Mean HbA_{1c} [%]	$HbA_{1c} \geq 7.0$ % proportion [%]	n	Mean HbA_{1c} [%]	$HbA_{1c} \geq 7.0$ % proportion [%]	n	Mean HbA_{1c} [%]	$HbA_{1c} \geq 7.0$ % proportion [%]
All	220	*7.4*†	*58.2*†	113	**7.5***	**60.2***	107	7.4	56.1
Age (years)									
18–34	63	**7.6***	**65.1***	30	**7.9***	**70.0***	33	7.2	**60.6***
35–44	59	7.2	50.8	35	7.1	54.3	24	7.2	45.8
45–54	44	**7.6***	**61.4***	19	7.4	**63.2***	25	**7.7***	**60.0***
55–64	33	7.4	54.5	16	**7.6***	**62.5***	17	7.2	47.1
65–74	19	**7.5***	57.9	11	7.2	45.5	8	**8.0***	**75.0***
75+	2	**8.2***	50.0	2	**8.2***	50.0	0	–	–
Duration of diabetes (years)									
0–4	24	7.4	45.8	11	**8.0***	54.5	13	6.8	38.5
5–9	28	**7.6***	57.1	14	**8.1***	**64.3***	14	7.1	50.0
10–14	25	7.4	**64.0***	16	7.4	**75.0***	9	**7.4***	44.4
15–19	22	7.1	50.0	10	7.2	50.0	12	7.1	50.0
20–24	26	**7.6***	**73.1***	16	**7.8***	**75.0***	10	7.3	**70.0***
25+	87	7.4	**59.8***	40	7.1	55.0	47	**7.7***	**63.8***
no data on duration	8	**7.6***	37.5	6	**7.5***	33.3	2	**7.7***	50.0

†overall mean HbA1c/overall proportion of persons with HbA1c ≥ 7 %

*mean HbA1c/proportion of people with HbA1c ≥ 7 % is above overall mean HbA1C/overall proportion

age of approximately 45, when women have a somewhat higher mean haemoglobin A_{1c}. Between approximately age 45 and approximately age 63, the curve for T2 diabetics is at a somewhat elevated level.

HbA_{1c} – treatment

Differences in the quality of diabetes control between the treatment groups were identified in the T2 diabetes population. **Table 1** already contains important information on the mean HbA_{1c}. In the DETECT population, the mean HbA_{1c} was 6.2 ± 0.8 % (both genders) in patients in the "no glucose lowering drug" treatment category (mean duration of diabetes 5 years), 6.9 ± 0.9 % (both genders) under treatment with OAD (mean diabetes history: 7 years), 7.5 ± 1.3 % (men: 7.5 % and women 7.6 %) under combination treatment (OAD & insulin, mean history of diabetes: 11.5 years), and, finally, 7.3 % (men 7.2 % and women 7.4 %) in subjects on insulin therapy (mean duration of diabetes 12.1 years). The corresponding prevalences in T2 diabetics with an $HbA_{1c} \geq 7.0$ % were as follows (see **Table 1**): 12.4 % in the "no glucose lowering drug" category (men: 13.0 %, women: 11.9 %), 39.6 % on oral drugs (men: 39.0 %, women 40.2 %), 63.4 % on combination treatment (men: 60.8 %, women: 65.4 %), and, finally, 54.9 % on insulin treatment (men 50.9 %, women 58.7 %).

The distribution of treatment modalities depending on HbA_{1c} is shown in **Fig. 4**.

The following percentages refer to the T2 diabetics with the reported treatment modality. Non-pharmacological treatment modalities predominate for lower HbA_{1c} values, but increasing numbers of T2D patients received oral treatment in response to HbA_{1c} levels of approximately 5.5 %. This treatment modality was then predominant for virtually all HbA_{1c} levels. The oral drug treatment percentage was 48.8 % (1249 out of 2558 patients) in the presence of an $HbA_{1c} < 6.5$ %, 54.3 % (1307 out of 2407) in those with an $HbA_{1c} \geq 6.5$ % & ≤ 7.5 %, and still 46.7 % in those with an $HbA_{1c} > 7.5$ % (696 out of 1492 patients). In the presence of HbA_{1c}-threshold values of 7.0 %, the cutoff point for intensifying treatment, in accordance with the NVL T2D 2002 step-up plan and other guidelines, oral treatment modalities peaked at approximately 55 %. One-third of patients with an $HbA_{1c} < 6.5$ % (852 patients) received non-pharmacological treatment. The figure was 13.4 % (322 patients) in those with an HbA_{1c} of ≥ 6.5 % and ≤ 7.5 %, and 4.1 % (61 patients) in those with an HbA_{1c} of > 7.5 %. Combination treatments consisting of OAD plus insulin, and insulin-alone treatments were more common, with an approximately equal level of use (24.3 % and 24.9 %, and 363 and 372 patients, respectively) among individuals with an HbA_{1c} > 7.5 %. In the patient population with an HbA_{1c} of < 6.5 %, only 6.3 % and 1.6 % of cases (161 and 296 patients, respectively) received these two treatment modalities. In the population with an $HbA_{1c} \geq 6.5$ % and ≤ 7.5 %, the corresponding figures were 14.2 % and 18.2 % of cases (341 and 437 patients, respectively).

Discussion

The comparison of the DETECT diabetic population with other surveys and databases in Germany shows a good level of agreement in terms of baseline parameters. Again, most of the data from these sources relates to T2D. In the DETECT cross-sectional survey of September 2003, 15.2 % of the patients had a confirmed diagnosis of diabetes as documented by the participating primary care physicians. In the ADT Panel ("**A**brechnungs-**d**aten**t**räger-Panel", North Rhine Panel Physician Region), a diabetes ICD Code E10 – E14 was stated for 10.9 % of patients seeing a general practitioner and 17.3 % of patients seeing a community-based internist in the fourth quarter of 2003 (ZI-ADT, 2007). It is important to note that the incidence of particular diagnoses often differs in Germany from region to region. For instance, a Thuringia Panel Physician Association paper dated October 2006 (Zenker, 2006) points out that diagnoses E10 – E14 are much more frequently issued by generalists in Brandenburg than in the North Rhine region (14.2 % of patients versus 10.6 %,

Table 3 Type 2 diabetes – proportion of patients with HbA1c ≥ 7.0 % by gender, age and duration of diabetes

HbA1c ≥7.0%		Total		0–4		5–9		10–14		15–19		20–24		25+		Duration of type 2 diabetes (years) no data on
Age (years)	n	thereof HbA_{1c} ≥7.0 % [%]	n	thereof HbA_{1c} ≥7.0 % [%]	n	thereof HbA_{1c} ≥7.0 % [%]	n	thereof HbA_{1c} ≥7.0 % [%]	n	thereof HbA_{1c} ≥7.0 % [%]	n	thereof HbA_{1c} ≥7.0 % [%]	n	thereof HbA_{1c} 7.0 % [%]	n	thereof HbA_{1c} ≥7.0 % [%]
All	6891	**38.8***	2479	27.0	1836	**40.3***	1223	**48.3***	491	**49.7***	340	**59.4***	223	**55.6***	299	34.1
18–34†	31	29.0	19	26.3	8	12.5	3	**66.7***	0	–	0	–	0	–	1	**100.0***
35–44	190	36.3	122	30.3	38	**42.1***	16	**50.0***	5	**60.0***	2	**100.0***	0	–	7	**42.9***
45–54	742	**42.0***	381	32.5	194	**46.9***	95	**61.1***	31	**51.6***	16	**81.3***	2	**100.0***	23	34.8
55–64	1676	**40.6***	674	28.6	474	**44.7***	267	**51.3***	94	**53.2***	69	**63.8***	21	**71.4***	77	37.7
65–74	2665	37.4	847	23.7	716	38.0	542	**47.0***	200	**45.5***	146	**58.2***	111	**53.2***	103	33.0
75+	1587	38.2	436	25.2	406	36.5	300	**43.7***	161	**52.2***	107	**54.2***	89	**53.9***	88	30.7
Male	3359	37.8	1218	27.5	939	**39.8***	587	**45.8***	228	**49.1***	142	**57.7***	105	**44.8***	140	35.7
18–34	10	**40.0***	6	**50.0***	4	25.0	0	–	0	–	0	–	0	–	0	–
35–44	96	37.5	67	32.8	14	**50.0***	9	**44.4***	2	**50.0***	0	–	0	–	4	**50.0***
45–54	426	**40.4***	213	29.6	127	**44.9***	51	**66.7***	15	**46.7***	9	**66.7***	0	–	11	**45.5***
55–64	880	**40.6***	352	31.5	250	**44.0***	147	**45.6***	50	**52.0***	36	**61.1***	9	**88.9***	36	36.1
65–74	1342	36.1	407	24.1	373	37.0	276	**41.7***	102	**47.1***	74	**55.4***	58	**41.4***	52	38.5
75+	605	35.7	173	22.0	171	35.7	104	**47.1***	59	**50.8***	23	**56.5***	38	**39.5***	37	27.0
Female	3532	**39.8***	1261	26.6	897	**40.8***	636	**50.6***	263	**50.2***	198	**60.6***	118	**65.3***	159	32.7
18–34	21	23.8	13	15.4	4	0.0	3	**66.7***	0	–	0	–	0	–	1	**100.0***
35–44	94	35.1	55	27.3	24	37.5	7	**57.1***	3	**66.7***	2	**100.0***	0	–	3	33.3
45–54	316	**44.3***	168	36.3	67	**50.7***	44	**54.5***	16	**56.3***	7	**100.0***	2	**100.0***	12	25.0
55–64	796	**40.6***	322	25.5	224	**45.5***	120	**58.3***	44	**54.5***	33	**66.7***	12	**58.3***	41	**39.0***
65–74	1323	38.8	440	23.4	343	**39.1***	266	**52.6***	98	**43.9***	72	**61.1***	53	**66.0***	51	27.5
75+	982	**39.7***	263	27.4	235	37.0	196	**41.8***	102	**52.9***	84	**53.6***	51	**64.7***	51	33.3

† overall proportion of persons with HbA_{1c} ≥ 7 %

* proportion of persons with HbA_{1c} ≥ 7 % is above overall proportion

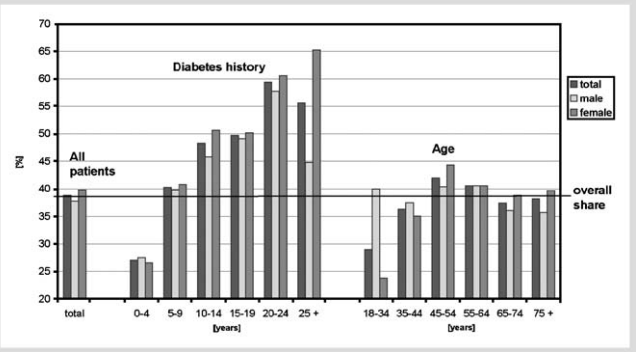

Fig. 1 Type 2 Diabetes - proportion of patients with HbA1c ≥ 7.0 % by gender, duration of diabetes and age.

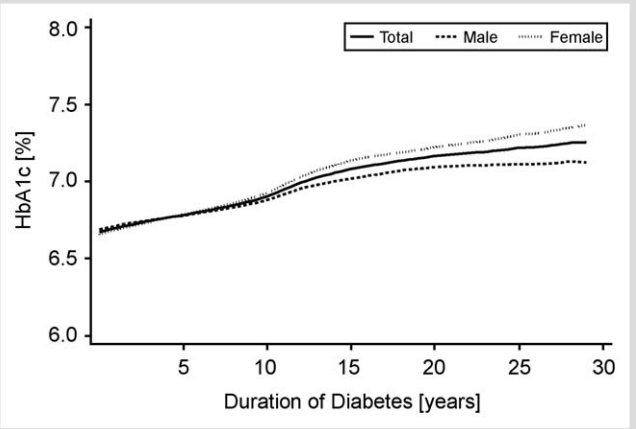

Fig. 2 Association of HbA1c and duration of diabetes in type 2 diabetes.

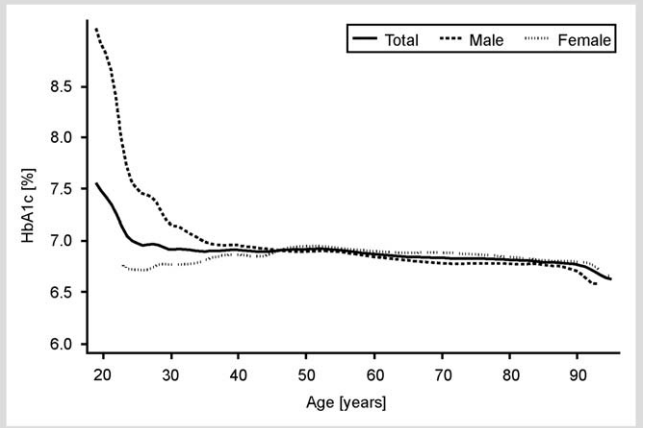

Fig. 3 Association of HbA1c and age in type 2 diabetes.

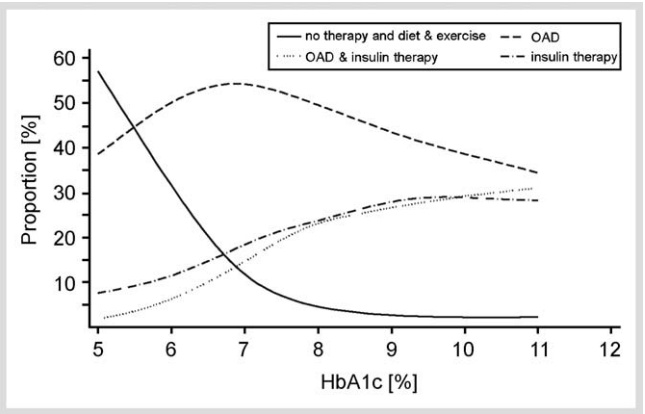

Fig. 4 Association of HbA1c and treatment modalities in type 2 diabetes.

first quarter of 2002). Diabetics see their doctor more frequently than non-diabetics. Hence, the percentage of patients with a documented diagnosis of diabetes in the nationwide DETECT point prevalence study is in the expected range, based on the regional figures available.

At first glance, the frequency of a diagnosis of T1D (see **Table 1**) in the DETECT sample appears to be rather low, in relation to the 0.5 % prevalence in the overall population cited among others by Häussler et al. (2006). In a point prevalence population such as for DETECT, one would expect a higher level than 0.5 %. However, it is important to remember that T1 diabetic patients in Germany more commonly receive treatment at special diabetology practices. According to Aldenhoven et al. (2002), 3.3 % of the diabetics treated by GPs in the database of the North Rhine Panel Physician Association Care Structure Agreement in 2001 were type 1 diabetics. The DETECT point prevalence study likewise reveals a percentage of 3.3 %.

The mean age of people with DM type 1 in the DETECT population (43.2 y; see **Table 1**) does not significantly differ from the 44.3 y in the general practitioner practices in the North Rhine Panel Physician Association Care Structure Agreement (2001). The mean duration of diabetes among the T1 diabetics in DETECT (20.8 y) is above the 13.9 y cited by Aldenhoven et al. (2002), however. The difference might be owing to differences in the classification of LADA patients.

The point prevalence for type 2 diabetes in DETECT is 14.7 %. This figure is well above the 6.9 % overall prevalence of diabetes in the German population as estimated by Hauner et al. (2003) for 2001. However, it is important to take into account that DETECT was limited to members of the population who were seeing a doctor during the survey period. The percentage of people with type 2 diabetes can be expected to be much higher here. 96.7 % of the people with diabetes in DETECT were assigned to the type 2 diabetes category; likewise in the GP practices in the North Rhine Panel Physicians Association database (2001) (Altenhofen et al., 2002). The average of people with T2D in DETECT was 66.3 y (± 10.6), which is similar to the figures in regional studies. North Rhine Panel Physicians Association Care Structure Agreement (2001) (Altenhofen et al., 2002) 66.6 y (± 11.5), North Rhine T2D Disease Management Programme 2005 (DMP T2D NR 2005) (Starke et al., 2006): 67.1 y (± 10.8), Marbach/Neckar district GP practices in the 2nd quarter of 2000 (Rothenbacher et al., 2005): 69 y, Sinsheim Diabetes Study (Uebel et al., 2004): 67 y (± 12.9), etc. The mean T2D disease history in DETECT, 7.8 y (± 6.8), is also within the range seen in other analyses, such as the North Rhine Panel Physicians Association Care Structure Agreement (2001) (Altenhofen et al., 2002) for GP practices: 6.8 y, and DMP T2D NR 2005 (Starke et al., 2006): 8.0 y (± 7.0). In agreement with other studies, the percentage of men is somewhat lower than the percentage of women in DETECT, both for T1D and for T2D (Altenhofen et al., 2002, Starke et al., 2006). In addition, women with T2D – as in other analyses – are somewhat older on average than men with T2D (Altenhofen et al., 2002, Starke et al., 2006). Finally, a comparison of the age structure of men and women with T2D in DETECT with those in DMP T2D NR 2005 (Table 5-1 North Rhine Disease Management Programs Quality Assurance Report 2005, p 44) (Zenker, 2006) discloses surprisingly "close"

values both for men and for women. The results of the DETECT point prevalence survey can be considered as being representative of primary care in Germany.

The results on quality of glycaemic metabolic control for the overall DETECT population (T1D: 7.4%, T2D: 6.9%) as determined via mean HbA_{1c} are likewise in full agreement with data from other studies: North Rhine Panel Physicians Association Care Structure Agreement for GPs (2001) (Altenhofen et al., 2002), T1D: 7.6%, T2D 6.9%; T2D Disease Management Programmes for North Rhinen (Starke et al., 2006) and Westphalia-Lippe 2005 (Qualitätsbericht, 2006) T2D 7.0%; Sinsheim Diabetes Study (Uebel, 2004): T2D 7.2%; "Diabetes in Germany" Study (DIG) (Ott, 2006): T2D 7.0%. All these values can be considered good on an international scale. Data from the National Health and Nutrition Examination Survey (NHANES) 1999–2002 & Behavioral Factors Surveillance System (BFSS) 2002, USA, reveal a mean level of 7.7% (18–75 y, HbA_{1c} measures standardized to DCCT) (Saaddine et al., 2006) for people with diabetes (T1D+T2D). A recent Canadian study, "Practice Diabetes Management Study" (Harris et al., 2006), reveal a mean HbA_{1c} of 7.7% for people with T2D.

The relatively good average HbA_{1c} levels in the German primary care setting must not detract from the fact that the human and economic burden of diabetes is very high. As recently been confirmed again in the KoDiM study, that the heavy economic burden does not accrue in equal measure from all diabetics (Köster et al., 2006). A limited number of patients with sequelae and complications requiring complex treatment share among themselves the bulk of the financial, and naturally also human, cost of the disease. Prevention of this human and economic cost of disease should be a top priority. A rational medical and economic response would be to identify patients as early as possible who harbour a (significantly) elevated risk of developing micro- and macrovascular complications, and provide them with more intensive treatment. At the very least, patients with an $HbA_{1c} \geq 7.0\%$ should have their diabetes regimen intensified, thus following treatment guidelines such as the US ADA and German Diabetes Association.

The proportion of people with DM type 1 in primary care with an $HbA_{1c} \geq 7.0\%$ is almost 60%, according to DETECT. In addition, the average HbA_{1c} is decidedly too high, at 7.4%. The problem is well known. As a result, people with DM type 1 tend to be treated in specialist diabetology practices (Altenhofen et al., 2002). Women seem to have better glycaemic control than men, with few exceptions, including women above the age of 65 and women with a long diabetes history of 25 y and more.

Although the average HbA_{1c} of 6.9% is relatively good for T2D, 38.8% of all people with DM type 2 with an HbA_{1c} of ≥7.0%, i.e. almost 4 out of 10, would have to undergo intensification of their treatment in accordance with the current guidelines. The situation is favourable with respect to the large number of patients with a short diabetes history, especially the older population. As can be seen among other things from the low prevalence of people with an $HbA_{1c} \geq 7.0\%$, these subgroups have fairly good glycaemic control. However, patients with T2D and a disease history of 10 years and more do not have such good glycaemic control (Altenhofen et al., 2002). In the North Rhine Panel Physicians Care Structure Agreement Database (2001) shows a mean HbA_{1c} of 7.4% was found in the subset of patients with a diabetes history in excess of 10 years. This is an even higher figure than in DETECT (7.15%). Both genders in age categories 45–54 y and 55–64 y have an impaired quality of glycaemic control in association with a diabetes history of 5–9 y. Younger men with a shorter diabetes history and women aged 65–74 with a 5–9 y disease history also have impaired control. Glycaemic control tends to be better in men than in women, exceptions being younger men up to an approximate age of 45.

The average rise in HbA_{1c} as a function of duration of diabetes in the DETECT cross-sectional survey - 0.08% points per year – is somewhat greater in the female sub-population than in the males. Though the "rise" in HbA_{1c} is not as great as in the UKPD study (UKPDS 33, 1998; UKPDS 34, 1998) (approximately 0.2% points per year), it is nevertheless marked. It is important to remember that a cross-sectional study like DETECT depicts a patient status which may cover a wide variety of patient biographies. The patient population in the UKPD study was more homogeneous because of the prospective (longitudinal) study design. Moreover, the UKPD study only recruited people with newly diagnosed T2D. DETECT does not reveal elevation of HbA_{1c} in association with age. In fact arithmetically speaking, there is even a slight reduction. The highest percentage of patients with inadequate glycaemic control in the T2D population is not found among the old; the 45–54 and 55–64 age groups are the heaviest affected in this regard. Rothenbacher et al. reported similar results in 2003. A study entitled "GP Practices in the Marbach/Neckar District, 2nd Quarter of 2000 (Rothenbacher, 2005) revealed the highest prevalences of HbA_{1c} levels ≥8.0% among 40–59 year olds. In terms of glycaemic control, the 45–54y and 55–64 y age groups hence represent a population with an elevated risk of diabetogenic complications.

The DETECT results further show: in primary care in Germany, treatment with oral antidiabetes drugs is the main treatment modality for T2D, no matter what the HbA_{1c}. Patients with low values and a shorter diabetes history commonly do without diabetes drugs. The data on the quality of diabetes control in this treatment group vindicates the underlying treatment decisions. In T2D patients with higher HbA_{1c} levels and a longer diabetes history, OAD/insulin combinations and insulin-alone regimens are more common, as is to be expected. The HbA_{1c} levels remain fairly high on both treatment modalities in the primary setting, however. The causes are likely to be manifold. The potentials shown for these two treatment modalities in the experimental settings of clinical trials do not seem to unfold fully in real-life settings, in the manner in which they are currently put into practice and, above all, when they are put into practice.

Interestingly, the mean age of patients receiving the various treatment modalities does not differ significantly.

Conclusion

T1D treatment in primary care is inadequate overall. Further improvement measures are required here. The situation is less clear-cut with respect to DM type 2. Glycaemic control is not poor overall, especially in patients with a shorter diabetes history. However, the inevitable impression is that the efforts of patients and physicians to achieve metabolic control tend to lag behind the actual metabolic deterioration in the bulk of the T2D population, especially when treatment needs to become more intensive and complex as a result of disease progression. Increased attention should be paid to people with DM type 2 with a 5–9 history of disease, before any loss of metabolic control. In addition, patients in the 45–54 and 55–64 age groups, and younger men require attention, i.e., people with T2D who are commonly still part of the working population.

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