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Assessment of the contribution of Check-up 35 to the early detection of target diseases in Germany

Abstract

Introduction: The Check-up 35 has been a central component of primary prevention in German general practice since 1989, yet evidence on its ability to detect targeted diseases remains limited. Therefore detection rates of the program's target conditions are examined in a large cohort of patients treated in German primary care.

Methods: In this retrospective cohort study using data from 1,216 primary care practices (IQVIA™ Disease Analyzer, 2019–2023), Check-up 35 participants were compared with non-participants through 1:5 propensity score matching. New diagnoses of arterial hypertension, diabetes mellitus, dyslipidemia, and chronic kidney disease (CKD) within three months after the check-up, are assessed versus a random index visit among controls. Medication prescriptions following diagnosis served as a secondary outcome.

Results: A total of 51,829 participants were matched to 259,145 non-participants. Participation was associated with higher diagnosis rates for hypertension (HR 1.56), diabetes (HR 1.69), dyslipidemia (HR 3.24), and CKD (HR 2.07). The association was particularly strong for dyslipidemia in individuals younger than 40 years (HR 5.10). Prescription rates after diagnosis were similar or lower among Check-up participants.

Discussion: These findings indicate that the Check-up 35 facilitates earlier detection of major chronic diseases. Increasing participation may strengthen preventive care in Germany.

Keywords

health check-up, prevention, primary care, dyslipidemia, arterial hypertension

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According to data from the European Observatory on Health Systems and Policies, cardiovascular diseases are the leading cause of death in Germany. A considerable proportion of these deaths is considered preventable (1). Large multinational studies have identified arterial hypertension, dyslipidemia, diabetes, body mass index and current smoking as the most important risk factors for cardiovascular disease and mortality (2). More recently, chronic kidney disease (CKD) has also been established as an independent risk factor for cardiovascular morbidity and mortality (3). Although randomized controlled trials and subsequent meta-analyses have failed to demonstrate an effect on mortality, health check-ups are an established part of care in many Western health systems (4, 5).

In Germany, the screening examination "Check-up 35" was introduced in 1989 to identify key risk factors for morbidity and mortality in the population. In brief, it comprises a medical history and physical examination, a blood test for dyslipidemia and fasting glucose, and a urine dipstick test for protein, glucose, nitrite, leukocytes and hemoglobin. Persons with statutory health insurance aged 35 and over are eligible every three years; persons aged 18 to 34 can use the examination once.

>> Most published studies on Check-up 35 examine participation in specific socioeconomic groups (6–9). Studies evaluating the effectiveness of Check-up 35, however, are largely lacking. Research in other countries' health systems, particularly in the United Kingdom and Denmark, has shown mixed results regarding the effectiveness of health check-ups in detecting targeted risk factors (10–12). To determine the impact of participation in Check-up 35 on detection rates of the target diseases mentioned, and to evaluate the resulting effects on drug prescriptions, a retrospective cohort study was conducted comparing participants and non-participants in German general practices.

Methods

Database

This retrospective cohort study is based on data from the Disease Analyzer database (IQVIA), which contains anonymized information on drug prescriptions, diagnoses and basic medical and demographic data from the practice management systems of general practitioners and specialists. The database covers >1,200 general practices in Germany and is considered representative of outpatient care (13).

Study population

The study included adults (≥18 years) with at least one visit to one of 1,216 general practitioners between January 2019 and December 2023. This time window was chosen because the Uniform Value Scale (EBM) for Check-up 35 was changed as of January 2019. For the analyses, persons with Check-up 35 (n = 1,365,445) were compared with persons without Check-up 35 (n = 4,841,157).

A complete Check-up 35 was defined by EBM codes 01732 (medical history/examination), 32880 (urine), 32881 (fasting glucose) and 32882 (lipid profile). These examinations serve primarily to screen for hypertension, diabetes, dyslipidemia and kidney disease. Blood pressure measurement was not standardized; abnormal values are usually verified by home measurements. Diabetes screening was based on fasting glucose, followed by HbA1c testing if abnormal. The lipid profile corresponds to the gold standard. CKD screening was limited to a non-standardized urine dipstick with low sensitivity.

To improve comparability, persons who received additional laboratory tests or had less than 12 months of observation before the index date were excluded. Also excluded were persons with

a pre-existing diagnosis of diabetes, dyslipidemia, hypertension or CKD, and persons with coronary heart disease (or stroke, as undercoding is likely here). Propensity score matching (1:5) was then performed by age, sex and obesity coded before the check-up.

Primary outcomes were first diagnoses of type 2 diabetes, arterial hypertension, dyslipidemia or CKD within three months of the index date. Due to quarterly billing, diagnoses are assumed to have been coded within this period at the latest. The index date was the date of the check-up or, in the control group, a randomly selected visit between 2019 and 2023.

Statistical analyses

The quality of propensity score matching was assessed using standardized mean differences (SMD); SMD < 0.1 was considered sufficient balance. The three-month cumulative incidence of the four diagnoses was analyzed using Kaplan-Meier curves to account for different follow-up times. Univariable Cox regressions were then performed to examine the association between Check-up 35 and the diagnoses, stratified by sex and age group. Results were reported as hazard ratios (HR) and 95% confidence intervals (CI). Due to multiple testing (12 models), $p < 0.001$ was considered statistically significant. Analyses were performed with SAS 9.4 (SAS Institute, Cary, USA).

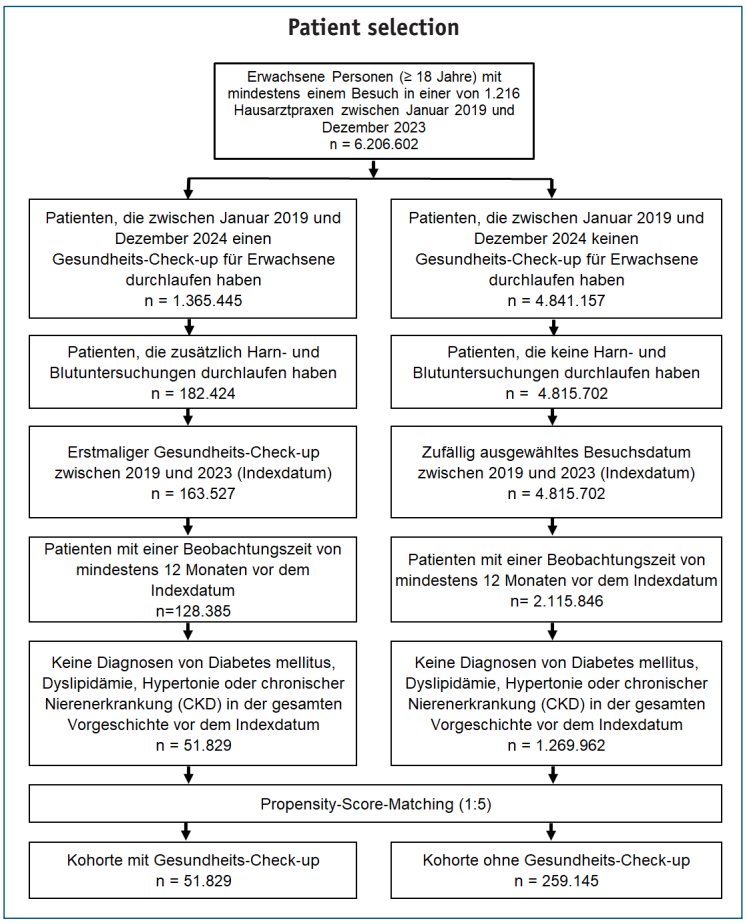


Fig. 1: Patient selection. Source: own illustration.

Results

In this study, 51,829 persons with a Check-up 35 were matched with 259,145 persons without Check-up 35 (Figure 1). The groups were well comparable, as shown in Table 1. The mean age of the cohorts was 47.8 years (SD 13.7), and all age groups were adequately represented. Almost 60% of persons were female, and the check-ups were evenly distributed over the years. Obesity was coded in only 5.7% of persons. All characteristics are listed in Table 1.

Three months after the check-up (Check-up 35 cohort) or the index date (controls), participants showed a significantly higher rate of newly coded diagnoses of arterial hypertension, dyslipidemia, type 2 diabetes mellitus and CKD than controls (Fig. 2). These associations persisted in univariate Cox regression analyses across age groups and in women and men. Particularly for dyslipidemia and CKD, participation in Check-up 35 was clearly associated with a subsequent diagnosis. The strongest association between participation and dyslipidemia was found in persons aged ≤40 years, with a more than fivefold increased risk (Table 2).

Discussion

Check-up 35 was introduced into the German health care system in 1989 and updated in 2019. Our study shows that participation in Check-up 35 is associated with a higher subsequent coding rate of the corresponding diagnoses – type 2 diabetes mellitus, arterial hypertension, dyslipidemia and CKD.

Health checks are well established, particularly in Western coun-

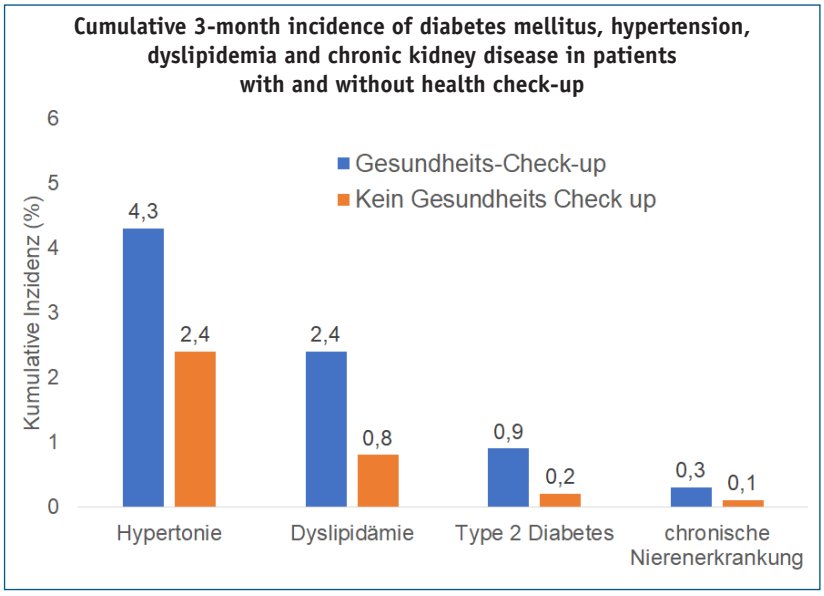


Fig. 2: Cumulative 3-month incidence of diabetes mellitus, hypertension, dyslipidemia and chronic kidney disease in patients with and without health check-up. Source: own illustration.

Baseline characteristics of the study population (after 1:5 propensity score matching)			
Variable	**Proportion of patients with Check-up 35 (N, %) N = 51.829**	**Proportion of patients without Check-up 35 (N, %) N = 259,145**	**SMD**
Age (mean, SD)	47,8 (13,7)	47,8 (13,7)	-0,011
Age <=40 years	16,817 (32,5)	84,075 (32,4)	
Age 41-50 years	13,565 (26,2)	67,812 (26,2)	
Age 51-60 years	12,610 (24,3)	63,000 (24,3)	
Age >60 years	8,837 (17,0)	44,258 (17,1)	
Women	31,036 (59,9)	155,221 (59,9)	0,000
Men	20,793 (40,1)	103,924 (40,1)	
Year of study inclusion			
2019	13,296 (25,7)	66,442 (25,7)	-0,001
2020	8,928 (17,2)	44,687 (17,2)	
2021	11,849 (22,9)	59,162 (22,8)	
2022	9,026 (17,4)	45,131 (17,4)	
2023	8,730 (16,8)	43,723 (16,9)	
Obesity diagnosis	2,966 (5,7)	14,736 (5,7)	-0,001

Table 1: Baseline characteristics of the study population (after 1:5 propensity score matching). Proportions of patients given as N and % unless otherwise stated. SD: standard deviation. SMD: standardized mean difference. Own illustration.

Association between health check-up and subsequent diagnoses of diabetes mellitus, dyslipidemia, hypertension and chronic kidney disease			
Patient group	**Incidence (cases per 1,000 patient-years) in persons with health check-up**	**Incidence (cases per 1,000 patient-years) in persons without health check-up**	**Hazard ratio (95% CI)**
Total	10,08	6,26	1,69 (1,58-1,81)*
Age <=40 years	4,43	2,34	1,84 (1,52-2,22)*
Age 41-50 years	8,88	4,91	1,85 (1,61-2,13)*
Age 51-60 years	11,38	7,70	1,58 (1,40-1,79)*
Age >60 years	19,35	14,29	1,47 (1,31-1,65)*
Women	8,67	5,58	1,60 (1,47-1,75)*
Men	12,31	7,29	1,82 (1,65-2,01)*
Dyslipidemia			
Total	48,54	11,85	3,24 (3,13-3,36)*
Age <=40 years	34,53	4,08	5,10 (4,68-5,56)*
Age 41-50 years	45,40	9,52	3,48 (3,33-3,74)*
Age 51-60 years	58,13	23,23	2,77 (2,60-2,95)*
Age >60 years	63,02	31,35	2,45 (2,27-2,63)*
Women	43,70	15,26	3,10 (2,95-3,25)*
Men	56,23	9,24	3,45 (3,27-3,64)*
Hypertension			
Total	42,65	27,89	1,56 (1,51-1,61)*
Age <=40 years	20,52	11,78	1,79 (1,64-1,95)*
Age 41-50 years	38,48	23,87	1,62 (1,51-1,73)*
Age 51-60 years	51,36	36,83	1,44 (1,35-1,52)*
Age >60 years	75,64	54,69	1,40 (1,32-1,49)*
Women	38,68	26,08	1,49 (1,42-1,55)*
Men	48,96	30,61	1,66 (1,58-1,75)*
CKD			
Total	4,14	1,99	2,07 (1,85-2,31)*
Age <=40 years	1,30	0,61	2,28 (1,60-3,26)*
Age 41-50 years	2,15	1,07	1,87 (1,40-2,50)*
Age 51-60 years	4,30	1,78	2,37 (1,89-2,96)*
Age >60 years	11,45	6,64	1,73 (1,48-2,02)*
Women	3,69	1,87	1,97 (1,70-2,28)*
Men	4,83	2,16	2,20 (1,87-2,60)*

Table 2: Association between health check-up and subsequent diagnoses of diabetes mellitus, dyslipidemia, hypertension and chronic kidney disease (CKD) in patients treated in German general practices (univariable Cox regression models). * = p<0.001. Own illustration.

tries. In Germany, there is a special focus on metabolic diseases and early cancer detection. For many of these examinations, however, specific studies – especially randomized controlled trials – evaluating their effectiveness for the early detection of the respective diseases are lacking. This study adds to the evidence by showing that participation in the version of Check-up 35 updated in 2019 is associated with a higher probability of a diagnosis of the diseases mentioned. This was particularly pronounced for dyslipidemia and CKD, underlining that these conditions often go unnoticed. Given that about 56.6% of men and 60.5% of women in Germany have dyslipidemia and around 11.9% of the adult population have CKD (14, 15), these results are plausible. They are largely consistent with studies from the British NHS showing that health check-ups markedly increase the detection of dyslipidemia and only slightly increase that of hypertension and diabetes (11, 16). This could indicate high awareness of hypertension and diabetes in primary care but low awareness of dyslipidemia and CKD.

Although all persons with pre-existing coded diagnoses before participation in Check-up 35 were excluded – as were persons with conditions such as coronary heart disease in whom undercoding of the target diseases is likely –, these results must be interpreted in the context of the study design. Selection bias cannot be completely ruled out: persons with a higher a priori risk of, e.g., hypertension may have received a Check-up 35 at an earlier point in time. Likewise, it cannot be ruled out that participants were more health-conscious or socioeconomically better off than the control group. However, a recently published study on integrating a liver fibrosis score into Check-up 35 showed that almost 50% of participants did not attend the recommended gastroenterological follow-up appointment, suggesting that disease awareness in this group is not substantially higher than in the general population (17).

The overall low detection rate of CKD in the cohort studied

highlights the limitations of the urine dipstick as a screening tool, especially given the high CKD prevalence of about 10% in the population (18–20). This underlines the need for more comprehensive screening methods, such as measuring serum creatinine to calculate the estimated glomerular filtration rate (eGFR).

To our knowledge, this is the first study to examine the effectiveness of Check-up 35 in detecting the target diseases. The main strength of this study is its large sample size, which allows thorough matching and robust analyses. Nevertheless, there are limitations. The analysis is based on ICD-10 codes and is therefore susceptible to undercoding, although this bias is likely to be similar in both groups. Another drawback is that the impact of Check-up 35 on hard clinical endpoints such as mortality could not be examined, as this information is not fully available in the Disease Analyzer database. The chosen three-month period for diagnoses may also have missed later diagnoses; a longer period, however, would have introduced additional bias. Moreover, we were unable to match the groups by geographic origin or socioeconomic status, which may lead to unobserved differences. Finally, Check-up 35 is a screening program specific to the German health care system, so the results cannot readily be transferred to other countries.

This study shows that participation in Check-up 35 in Germany is associated with a higher subsequent coding rate of the corresponding diagnoses. These results thus point to the benefit of Check-up 35, and broader participation in the population should be encouraged, especially since preventive measures, which include check-ups, will gain in importance and relevance in the future due to demographic change combined with increasingly tight health budgets. <<

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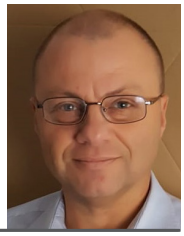
Author declaration

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