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Prevalence and incidence of depressive disorder: the Baltimore ECA follow-up, 1981–2004

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Abstract

Objective—To describe trends in prevalence and incidence of depressive disorder in a cohort from Eastern Baltimore.

Method—Twenty-three-year-old longitudinal cohort, the Baltimore Epidemiologic Catchment Area Follow-up. Participants were selected probabilistically from the household population in 1981, and interviewed in 1981, 1993, and 2004. Diagnoses were made via the Diagnostic Interview Schedule according to successive editions of the American Psychiatric Association Diagnostic and Statistical Manual.

Results—Older age, lower education, non-White race, and cognitive impairment are independent predictors of attrition due to death and loss of contact, but depressive disorder is not related to attrition. Prevalence rates rise for females between 1981, 1993, and 2004. Incidence rates in the period 1993–2004 are lower than the period 1981–1993, suggesting the rise in prevalence is due to increasing chronicity.

Conclusion—There has been a rise in the prevalence of depression in the prior quarter century among middle-aged females.

Keywords

depression; trend; cohort; sex

Introduction

More than a dozen epidemiologic studies around the world have presented data suggesting that depression has become more common in the last half century(1–4), but the idea is controversial (5). All but three of these studies have estimated cumulative lifetime

prevalence in cross-sectional samples, relying heavily on recall of the occurrence of the features of depression, as well as the age of onset of the first episode. Simulation models of forgetting provide simple explanations consistent with these data (6, 7), and there is strong, but not unanimous, evidence that considerable forgetting of episodes occurs (8, 9). One recent analysis found an increased prevalence of recent depression (as opposed to life-time occurrence) in independent samples of the United States population in 1992 and 2002 (10).

There are only two studies which have provided longitudinal data on trends in the incidence of depression. In rural Sweden, the annual incidence of depressive disorder nearly doubled from the period 1947–1957, to the period 1957–1972, leading the investigators to suggest we might be entering an ‘Age of Melancholy.’ (11) A follow-up of this same population in 1997 divided the time periods more equally into 1947–1972, with an incidence of depression of 4.4/1000/year, versus 1972–1997, with an incidence of 3.5/1000/year (12, 13). In rural Atlantic Canada, the lifetime and 1-year prevalence of depression was relatively stable between 1970 and 1992, but there was a suggestion of an increase in prevalence among young females during that period (14). The annual incidence of depressive disorders in that same population, based on a handful of new cases, declined slightly between the periods 1952–1970 and 1970–1992 (15).

Aims of the study

The current paper provides new longitudinal evidence on this issue, using three waves of data from the Baltimore Epidemiologic Catchment Area follow-up, to estimate the prevalence in 1981, 1993, and 2004; and the incidence over the time periods 1981–1993, and 1993–2004.

Material and methods

Samples

In 1981, 175 211 household residents of Eastern Baltimore were sampled probabilistically for participation in the Baltimore site of the Epidemiologic Catchment Area Program (16, 17). Persons over the age of 65 were purposively oversampled by designating all members of the household for interview, as well as whoever in the household was designated from a random selection. Four thousand two hundred and thirty-eight persons were designated for the sample and 3481 completed the interview (18). One year later, 2768 of these were interviewed, but as the time period is so short compared with the overall length of the follow-up, this analysis does not use data from wave 2 in 1982. From 1993 through June of 1996, 1920 of those interviewed in 1981 were interviewed again (19) (Since most of the interviews occurred in 1993, this year is used as shorthand (‘1993’) to designate this wave of the cohort study). In 2004 and the first half of 2005, 1071 of those interviewed in 1993 were interviewed again (likewise the shorthand of ‘2004’ is used for this wave). Attrition in the study was cumulative, in that the target sample for interviews in 2004 consisted only of those successfully interviewed in 1993.

The research was approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board.

Measures

The Diagnostic Interview Schedule (DIS) was used in all three waves in East Baltimore (20). Anticipating the possibility of analysis of trends, every effort was made to make the interview and survey procedures as similar as possible between waves. In 1981, the DIS version III (21) was used; in 1993 and 2004, the DIS version III-R(22) was used. There were 17 symptom items relevant to the diagnosis of DSM-III Major Depressive Disorder in 1981.

These items were retained word for word in most cases, and ten additional items added in the Revised DIS-III-R. Between 1993 and 2004, every single item in the section of the interview used to diagnosis Major Depressive Disorder was retained with identical wording, and the questions occurred in the identical order in the interview in 1993 and 2004. The order of sections of the interview was nearly identical in each of the three waves, with the section on depression following questions about demographic status, physical health, health services, general distress, and anxiety. In all three waves the section on depression began after about 40 min of interview. Interviewers were recruited, trained, and supervised by the same survey company at all the three waves (SRA/Battelle). The training of interviewers took about 1½ weeks in all the three waves. In 1981 and 1993, the same survey director guided the interview and survey operations; in 2004, the deputy director from 1993 guided the survey operations. In 2004, the interviewers used laptop computers to guide them, but interviewers directed all the questions at the respondents themselves, as in earlier waves. An algorithm for making the diagnosis in 1981 was designed for the DSM-III diagnosis. It was changed slightly in the Revised DSM-III-R diagnosis. The DSM-IV diagnosis is nearly identical to the DSM-III-R diagnosis, and the same algorithm was used for both.

Missing data among participants

Some respondents were so ill or so cognitively impaired that the interview was shortened, or conducted by proxy respondents. This situation eventuated in missing values for diagnostic and other variables in about 1–10% of the respondents. There were also several dozen telephone interviews in 1993 and 2004 that had this pattern. In 1981, 1993, and 2004, values were imputed for missing data involving 43, 45, and 39 variables respectively. The variables included a range of domains including sociodemographic characteristics, physical functioning, psychopathology, use of health services, and medical conditions. Imputations were conducted using the sequential regression method, as implemented in IVEWARE (23). This method assumes that the data are missing at random. Data missing in any given wave were imputed from data available at that wave and four variables from each earlier wave, representing psychopathology (cognitive impairment – total Mini-Mental score; emotional problems – lifetime diagnosis of depressive disorder; behavioural deviance – diagnosis of alcohol abuse or dependence, and diagnosis of drug abuse or dependence). Overall, five imputed datasets were created. Confidence intervals presented below incorporate the uncertainty resulting from the imputation process.

Attrition among participants in the baseline interview

A summary of the attrition, condensing the process from baseline to 1993 follow-up, and 1993 to 2004, is shown in Fig. 1. In both 1993 and 2004, about 73% of those interviewed in the prior wave and alive at the time of the follow-up were located and interviewed. At each wave, those not located, or those who refused to participate, were not sought at the later wave, so that the attrition cumulates to 53% of the survivors of the sample interviewed in 1981 being interviewed in 2004. The vital status for all individuals in the baseline survey was obtained through 2003 at each wave from the National Death Index (24, 25), and supplemented by field work for deaths in 2004. Attrition weights were calculated to allow generalization of inferences to the entire sample of those alive at each wave from the 3481 respondents at baseline in 1981 (26). The weighting procedure compensates for the possibility that individuals with certain characteristics might be more heavily represented in earlier waves of the study than in later waves, by over-representing individuals in the group who completed interviews, who are similar to those alive but not present at the given follow-up. Among all the five imputed data sets, the attrition weights varied between 1.0 and 3.0, with a handful over 5, and ten weights with a value higher than 10.0. The response model at the 1993 wave was checked by comparing the weighted distribution of baseline variables for

the participants and living non-participants. The nearly identical nature of the distributions demonstrated the adequacy of the models.

Statistical analysis

Prevalence data are reported as probabilities with confidence intervals, estimated taking into account the imputation and weighting process. Comments are provided when there are substantive differences between weighted and unweighted analyses. The method of Generalized Estimating Equations was used to pool data from all three waves to adjust for variables associated with the evolving demographic distribution of the cohort over time (27). For incidence the actuarial method was used on unweighted data as described in a previous paper by Eaton and colleagues (1997).

Results

Attrition

Forty-two per cent of the sample interviewed in 1981 had died by the time of the interview in 2004 (Fig. 1). This percentage reflects the oversampling of elderly conducted in the baseline survey, as older persons were strongly over-represented in this mortality (Table 1: OR of 57.7 for those over 65 in 1981). Males, non-Whites, and those with lower education were significantly over-represented in the mortality as well. Even after adjusting for age, cognitive impairment in 1981 was a strong predictor of death (OR of 5.2), but other aspects of psychopathology were not strong predictors of mortality, with the exception of moderately strong effects for Drug Abuse/Dependence (OR of 1.6), Mania (OR of 3.3), or Antisocial Personality (OR of 2.8). Depressive Disorder was not a significant predictor of mortality (OR of 0.8, 95% CI, 0.5–1.4).

The primary reason for the loss of contact with an individual is change in residence, especially a move to a residence outside the survey area. More than 10% of the survivors of the sample interviewed in 1981 were lost to follow-up either in 1993 or 2004, cumulating to 26% of survivors (Fig. 1). Persons at both ends of the age range were more likely to be lost, as shown in Table 1 (i.e., those 18–29 in 1981, as well as those over 65 in 1981). Non-White respondents, as well as those with lower education, were more likely to be lost to follow-up (Table 1). Loss of contact between baseline and follow-up was strongly related to baseline cognitive impairment (OR of 7.9), but no other variable related to psychopathology had a strong influence on loss of contact. In the follow-up waves, slightly more than 10% of those located declined to participate again, cumulating to 29% of those located in 2004 (Fig. 1). Respondents who were older, White, and with lower educational attainment, were more likely to decline (Table 1). Depressive disorder at earlier waves was not associated with attrition due to death, loss of contact, or refusal to participate at later waves, and analyses below without adjustment for attrition, not shown, are not materially different from the results presented.

Prevalence

At all the three waves of interviews, and consistent with the data from all the five ECA sites at baseline, (28) the prevalence of depression has roughly the same form, with a higher prevalence among females than males, and higher prevalence among those aged 30–44 than earlier or later ages (Table 2). The overall proportion of the respondents who report symptoms consistent with an episode of Major Depressive Disorder in the year prior to the interview does not change much (Table 2: 2.8% in 1981 vs. 2.7% in 2004), but there is a difference by gender. The prevalence of depression in males is stable or even declining, over this period, in each age group, but rising strongly for women aged 30–44 and 45–64 (Table 2). For example, the prevalence among females who are 30–44 at the time of the interview is

6.3% in 1981, declines slightly to 5.1% in 1993, and rises to 11.0% in 2004; for those 45–64 at the time of the interview, the rise is roughly linear from 2.2% to 3.3% to 4.3%. The trends are strong, with a doubling in prevalence or nearly so, but the 95% confidence intervals overlap; so, the trend does not reach normal levels of statistical significance. This difference could possibly be distorted by the distinct age composition of the group aged 30–44 in 2004. As the minimum age in 1981 was 18, and 23 years had passed to the time of the field work in 2004, the group aged 30–44 was truncated, being composed entirely of persons aged 41–44. But when the prevalence of depression in the narrower age range of 41–44 is compared in 1981, 1993, and 2004, the results are similar to those in Table 2 (prevalence in unweighted data of 5.2 in 1981, 5.1 in 1993, and 14.6 in 2004, data not shown).

Epidemiologic studies show that the prevalence of depressive disorder is often associated with common sociodemographic factors such as in Table 3 (29). As the cohort ages, its composition with respect to these factors changes. The effect of the wave of interview (e.g., 2004 vs. 1981) remains strong after adjusting for sociodemographic factors such as older age, being married, or being employed, and is statistically significant (Odds ratio of 1.99, 95% CI 1.2–3.4). These demographic statuses are protective as shown in the unadjusted models in Table 3, but slightly more prevalent in 2004 than 1981 (Table 1), which explains the change in odds ratio from 0.82 in the unadjusted model to 1.99 in the adjusted model in Table 3.

Incidence

Changes in the prevalence of depression could be explained by changes in its chronicity, or changes in incidence, or a combination of the two aspects. The Baltimore ECA data suggest that much or all of the trend is arising from new chronicity, because the incidence rates shown in Table 4 are relatively stable. The overall estimate for the time period 1981–2004 is 2.8/1000/year (93 new cases in 32 854 person years of exposure; 95% CI 2.3–3.5, not shown). But the incidence of depressive disorder actually declines from 3.2 per 1000 person years (95% CI 2.5–4.0) in the period 1981–1993, to 1.9 (95% CI 1.2–3.0) during the period 1993–2004 (Table 4). The decline occurs in all age by sex groups except for those aged 45–64, where the incidence rises slightly, but not significantly, for both males and females. The relationship of age to the incidence of depressive disorder, reported earlier for the period 1981–1993, is virtually unchanged with the addition of new cases from 1993–2004 (data not shown).

Discussion

These results do not suggest an epidemic of depression, or that we are entering an age of melancholy, consistent with reports from Lundby and Stirling County (12, 15). The rise in prevalence among females is consistent with other national data on trends in the United States (10). As the incidence is stable or even declining, the results suggest that the chronicity of depressive disorder is rising among females in late middle age. The combination of stability or decline in incidence with a rise in prevalence among females is similar to results from Atlantic Canada, with the exception that the rise in prevalence there was in younger females (30). The calendar time difference in the two studies (1970–1992 vs. 1993–2004) is such that the younger females in the Baltimore cohort would be middle-aged, again suggesting consistency between these two very different North American samples. These results suggest that earlier cross-sectional/retrospective findings on cohort effects in depression may possibly be due to changes in chronicity, coupled with the tendency to forget or deny the occurrence of depression for those who have recovered.

There are important limitations to these data. A cohort study is not the preferred approach for analysis of secular trends, although it has the advantage of combining the study of

incidence with prevalence. Only one community is included in the study. The cohort approach suffers from problems of attrition. The analyses presented used new techniques to adjust, as much as possible, for attrition; and analyses performed without adjustment (not shown) reveal results which are only trivially different from the adjusted data. The adjustments minimize, but do not eliminate, biases which may arise due to attrition.

The rise in prevalence for females is apparently not due to changes in the prevalence of substance use disorders (10). A possible explanation for the rise in depression is that the increased availability and use of treatment for depression (31), and direct-to-consumer advertisements for depression during the last decade in this country (32), have increased the recognition of depression, and lowered the stigma attached to reporting depression, so that more respondents recall and report it. However, this logic does not explain the lack of change in chronicity of depression for men. A third possible explanation is that that new roles of women have increased time pressures on them (33). A fourth possibility is that the rising trend in depression reflects the widespread weakening of social ties of all kinds, as suggested by the authors of the earlier cross-sectional cohort studies (1). Social integration in virtually all its forms has been declining over the decades (34, 35), and divorce is on the rise (36). Both divorce and the absence of social supports are strong candidates as risk factors for depressive disorder (37). The effects of social supports are stronger for females than males, and the effects of social support exist both for new onsets and recurrences (38). These and other possibilities deserve further exploration.

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Significant outcomes

- The prevalence of depressive disorder is increasing among middle-aged females, but the trend in the incidence is either stable or declining.

Limitations

- There has been attrition from the cohort since the baseline contact.

Attrition Experienced in Baltimore ECA Followup 1981–2004

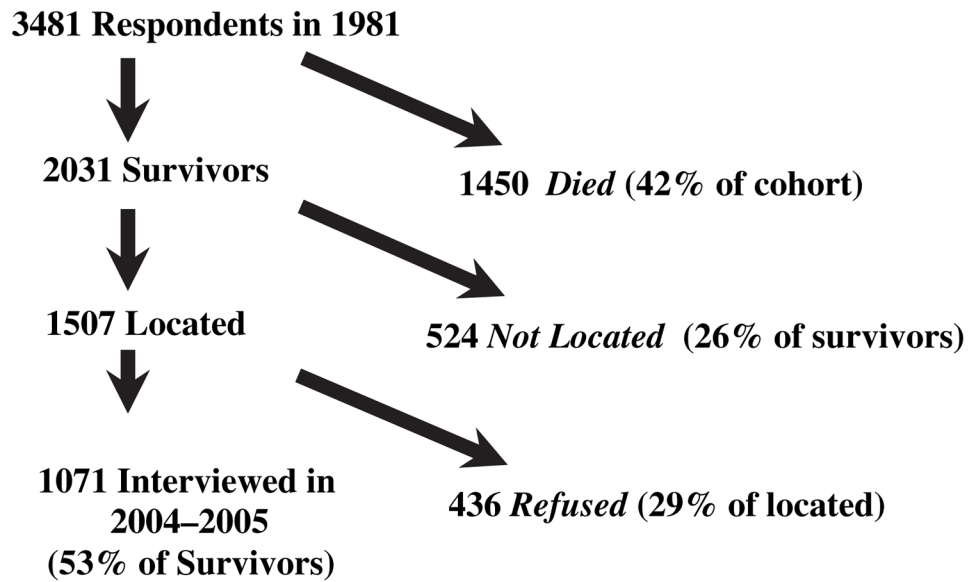


Fig. 1.
Attrition in the Baltimore ECA follow-up, 1981–2004.

Table 1
Sample characteristics in 1981 and 2004, with predictors of attrition Baltimore ECA follow-up

	Proportion in		Adjusted* odds ratios of			
	1981 (n = 3481)	2004 (n = 1071)	Death (n = 1450)	Lost (n = 524)	Refusal (n = 436)	
Age at interview						
18-29	25.2		0.5 (0.4-0.8)	1.3 (1.0-1.6)	1.1 (0.8-1.4)	
30-44	23.6	7.6	1.0	1.0	1.0	
45-64	24.0	65.6	7.6 (5.7-10.2)	0.7 (0.5-0.98)	2.0 (1.5-2.7)	
65+	27.2	26.8	57.7 (37.1-89.7)	2.3 (1.4-3.9)	1.8 (1.0-3.3)	
Gender						
Female	62.0	62.9	1.0	1.0	1.0	
Male	38.0	37.1	2.2 (1.7-2.7)	1.1 (0.9-1.4)	0.96 (0.8-1.2)	
Race						
Non-White	37.0	38.2	1.0	1.0	1.0	
White	63.0	61.8	0.7 (0.6-0.9)	0.5 (0.4-0.7)	1.4 (1.1-1.9)	
Education						
College graduate	7.2	19.1	1.0	1.0	1.0	
Some college	11.4	22.2	1.5 (0.9-2.6)	1.2 (0.8-1.9)	1.5 (0.9-2.5)	
High school graduate	31.6	35.0	1.6 (1.0-2.6)	1.2 (0.8-1.8)	1.8 (1.2-2.8)	
Some high school	38.9	21.1	3.2 (2.0-5.0)	2.1 (1.4-3.3)	2.5 (1.6-4.0)	
Elementary school graduate	6.1	1.7	4.2 (2.1-8.5)	2.6 (1.2-5.7)	3.2 (1.4-7.1)	
Some/no elementary school	4.9	0.8	3.7 (1.6-8.6)	4.3 (1.7-10.8)	2.6 (0.8-8.1)	
Work force participation						
In work force	42.0	56.4	0.4 (0.35-0.6)	0.7 (0.5-0.9)	1.1 (0.8-1.4)	
Not in work force	58.0	43.6	1.0	1.0	1.0	
Marital status						
Married	42.3	54.2	0.7 (0.6-0.9)	0.6 (0.5-0.8)	1.1 (0.8-1.3)	
Not married	57.7	45.8	1.0	1.0	1.0	
Psychiatric disorders						
Cognitive impairment	1.8	0.1	5.2 (0.7-39.7)	7.9 (0.97-64.3)	2.0 (0.1-31.7)	
Alcohol abuse/dependence	12.6	11.7	1.3 (0.9-1.8)	1.3 (0.9-1.8)	0.8 (0.6-1.2)	

	Proportion in			Adjusted* odds ratios of		
	1981 (n = 3481)	2004 (n = 1071)	Death (n = 1450)	Lost (n = 524)	Refusal (n = 436)	
Drug abuse/dependence	5.0	7.5	1.6 (0.99-2.7)	0.99 (0.7-1.5)	0.96 (0.6-1.6)	
Schizophrenia	1.8	2.7	0.9 (0.4-1.9)	0.6 (0.3-1.2)	0.7 (0.3-1.6)	
Major depression	4.4	5.8	0.8 (0.5-1.4)	1.3 (0.8-2.0)	0.8 (0.5-1.4)	
Mania	0.6	0.6	3.3 (0.9-10.2)	1.1 (0.3-4.3)	0.95 (0.2-4.8)	
Antisocial personality	2.0	1.7	2.8 (1.4-5.7)	1.7 (0.8-3.5)	1.2 (0.5-2.9)	
Obsessive-Compulsive	3.2	4.6	0.6 (0.3-1.1)	0.5 (0.2-0.9)	0.7 (0.4-1.4)	
Phobia	24.8	24.8	0.9 (0.7-1.1)	1.2 (0.9-1.5)	0.9 (0.7-1.2)	
Panic	1.4	1.7	0.8 (0.3-2.1)	1.4 (0.9-3.0)	0.7 (0.2-1.9)	
Somatization	0.1	0.2	-	0.9 (0.1-11.4)	-	
Each additional disorder	38.0	40.2	1.0 (0.9-1.2)	1.1 (0.9-1.2)	0.9 (0.8-1.03)	
Suicide attempt	3.5	3.7	1.6 (0.9-2.9)	1.3 (0.8-2.3)	0.8 (0.4-1.6)	
Suicidal ideation	8.0	10.8	1.1 (0.7-1.7)	0.9 (0.6-1.4)	0.5 (0.3-0.8)	
Ever used drugs	24.9	37.0	1.2 (0.9-1.8)	1.1 (0.9-1.4)	0.9 (0.7-1.2)	

Sample not weighted.

* Coefficients for age, gender, race, and education are adjusted for each other; other coefficients are adjusted for age, race, gender, and education.

Prevalence of DIS/DSM major depressive disorder in year prior to interview 1981, 1993, 2004; Baltimore Epidemiologic Catchment Area Follow-up

Table 2

Age at interview	1981 (DSM-III)		1993 (DSM-III-R)		2004 (DSM-IV)	
	Males	Females	Males	Females	Males	Females
18-29	2.1 (0.9-4.3)	4.6 (3.0-6.7)	-	-	-	-
30-44	2.4 (1.1-4.8)	6.3 (4.3-8.8)	1.7 (0.7-4.2)	5.1 (3.3-7.7)	0	11.0 (4.5-24.8)
45-64	2.0 (0.7-4.3)	2.2 (1.2-3.9)	0.2 (0.01-3.7)	3.3 (1.9-5.7)	1.3 (0.4-3.7)	4.3 (2.7-6.6)
65+	0.3 (0.001-1.6)	1.2 (0.5-2.5)	0.5 (0.04-5.2)	0.7 (0.2-2.6)	0.0	0.0
All ages	1.7 (1.1-2.5)	3.5 (2.7-4.3)	0.95 (0.4-2.2)	3.2 (2.3-4.4)	0.9 (0.3-2.5)	3.8 (2.6-5.6)
Total	2.8 (2.3-3.4)		2.4 (1.7-3.2)		2.7 (1.8-3.9)	
N Interviewed	1322	2159	707	1213	397	674
N Survived	1322	2159	950	1683	513	907

Values are in percentage, with 95% confidence intervals in parentheses Confidence intervals for weighted and imputed data as described in the text

Table 3

Crude and adjusted association of wave of interview and demographic variables with depressive disorder; data with imputations, $n = 7564$ Odds Ratios and 95% Confidence Intervals

	Depressive disorder	
	Crude	Adjusted
1993 vs. 1981	0.81 (0.6–1.2)	1.30 (0.8–1.9)
2004 vs. 1981	0.82 (0.5–1.2)	1.99 (1.2–3.4)
Female	2.32 (1.5–3.6)	2.30 (1.4–3.6)
White	0.88 (0.6–1.2)	1.48 (1.0–2.2)
Employed	0.99 (0.7–1.4)	0.74 (0.5–1.0)
Age in years	0.97 (0.96–0.98)	0.96 (0.95–0.97)
Years of education	1.03 (0.99–1.1)	0.97 (0.91–1.04)
Married	0.51 (0.35–0.7)	0.52 (0.35–0.76)

Table 4

Incidence of DIS/DSM-IIIR major depressive disorder per 1000 person-years 1981–1993, and 1993–2004; Baltimore Epidemiologic Catchment Area follow-up

Age at start of follow-up period	1981–1993			1993–2004		
	Males	Females	Total	Males	Females	Total
18–29	1.5 (0.2–5.2)	4.5 (1.9–8.8)	3.2 (1.5–5.8)	-	-	-
30–44	3.8 (2.0–6.5)	6.5 (4.5–9.2)	5.4 (4.0–7.4)	1.5 (0.2–5.5)	4.5 (2.0–8.9)	3.2 (1.6–5.9)
45–64	0.9 (0.1–3.2)	2.4 (1.1–4.6)	1.9 (0.9–3.3)	0.9 (0.1–3.4)	2.6 (1.2–4.9)	1.9 (1.0–3.5)
65+	0.7 (0.0–3.7)	1.0 (0.2–2.8)	0.9 (0.2–2.2)	0.0	0	0
All ages	2.1 (1.3–3.3)	3.9 (2.9–5.1)	3.2 (2.5–4.0)	0.9 (0.3–2.4)	2.6 (1.5–4.1)	1.9 (1.2–3.0)
New cases	18	53	71	4	17	21

Values are in percentage, with 95% confidence intervals in parentheses