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Paradoxical trends in mental health in the society and the root causes of increased mental health problems among young people. The HUNT Study, Norway

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Paradoxical trends in mental health in the society and the root causes of increased mental health problems among young people. The HUNT Study, Norway

Steinar Krokstad (000-0002-2932-6675), Daniel Albert Weiss, Morten Austheim Krokstad, Vegar Rangul, Kirsti Kvaløy, Jo Magne Ingul, Ottar Bjerkeset, Jean Marie Twenge, Erik Reidar Sund.

Steinar Krokstad, professor, HUNT Research Centre, Department of Public Health and Nursing, Norwegian University of Science and Technology, 7600 Levanger, Norway.

Daniel Albert Weiss, associate professor, Nord University, Faculty of Social Sciences, Universitetsalléen 11, 8026 Bodø, Norway.

Morten Austheim Krokstad, PhD Fellow, Faculty of Health Sciences and Nursing, Nord University, 7600 Levanger, Norway.

Vegar Rangul, associate professor, HUNT Research Centre, Department of Public Health and Nursing, Norwegian University of Science and Technology, 7600 Levanger, Norway.

Kirsti Kvaløy, professor, HUNT Research Centre, Department of Public Health and Nursing, Norwegian University of Science and Technology, 7600 Levanger, Norway.

Jo Magne Ingul, psychologist, Levanger Hospital, Nord-Trøndelag Hospital Trust, 7600 Levanger, Norway.

Ottar Bjerkeset, professor, Faculty of Health Sciences and Nursing, Nord University, 7600 Levanger, Norway.

Jean Marie Twenge, professor, Department of Psychology, College of Sciences, San Diego State University, San Diego, CA 92182-4611, USA.

Erik Reidar Sund, senior researcher, HUNT Research Centre, Department of Public Health and Nursing, Norwegian University of Science and Technology, 7600 Levanger, Norway.

Correspondence to: Steinar Krokstad (000-0002-2932-6675) steinar.krokstad@ntnu.no

Abstract

Objectives. Public health trends are formed by political, economic, historical, and cultural factors in society. The aim of this study was to examine changes in mental health among adolescents and adults over three decades, and discuss these changes based on current understandings of health promotion and disease prevention strategies.

Design. Repeated population-based health surveys to monitor decennial changes.

Setting. Data from three cross-sectional surveys in 1995-97, 2006-08 and 2017-19 in the population-based HUNT Study in Norway were used.

Participants. The general population in a Norwegian County covering participants aged 13 to 79 years, ranging from 48 000 to 62 000 in each survey.

Main outcome measures. Prevalence estimates of subjective anxiety and depression symptoms stratified by age and gender were assessed using the Hopkins Symptom Check-List 5 (HSCL-5) for adolescents and the Hospital Anxiety and Depression Scale (HADS) for adults.

Results. Adolescents' and young adults' mental distress increased sharply, especially between 2006-08 and 2017-19. However, depressive symptoms instead declined among adults ages 60 and over.

Conclusions. Our data from the HUNT Study in Norway indicate a strong increase in mental health symptoms among adolescents and young adults that we suggest to be related to marked behavioral changes in the population driven by economic and political factors and the increased use of information technology.

Strengths and limitations of this study

- The HUNT Study is a large general county population health survey repeated every decade since the 1980s in Norway, suitable to follow trends in public health
- The total population 13+ years are invited to the surveys with no upper age limit
- Identical screening tools for measuring mental symptoms have been used in all three surveys covered by this article; Hopkins Symptoms Check List 5 for adolescents and Hospital Anxiety and Depression Scale for adults
- Data covered approximately 70% of the total adolescent population and 70% to 54% of the total adult population with the risk of selection bias
- Changes in socio-cultural and behavioral attitudes towards depression, anxiety, and mental health in general the recent years, may have made it easier for participants to report mental health concerns and express emotion in questionnaires

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Introduction

Mental health problems are among the leading causes of disease burden worldwide.^{1,2} Further, mental health issues are primary drivers of disability worldwide, causing over 40 million years of disability in 20 to 29-year-olds.³ Depression alone accounts for more disability-adjusted life years (DALYs) than all other mental disorders together⁴ and is projected to become the leading cause of disability in high-income countries by 2030.⁵ Thus, the public health burden of mood disorders is substantial, with negative effects including functional problems, reduced quality of life, disability, low work productivity, increased mortality, and increased health care utilization.

In Norway, estimates of years lived with disability in 2016, display anxiety and depression ranked as number four and seven on the list of the most contributing diseases in the Global Burden of Disease statistics.⁶ Mental disorders are highly prevalent in disability benefit statistics, with awards often granted at younger ages than for other diagnoses. Mental disorders have additionally been shown to be responsible for the most working years lost (33.8%) of any disability.⁷

During the last decade, rates of depressive symptoms have increased in several adolescent populations.⁸ In the USA, rates of depression, self-harm, and suicide attempts increased substantially in adolescents after 2010.⁹⁻¹¹ On the other hand, data have paradoxically shown an improvement in mental health with age indicating the opposite trend among older people.^{12,13}

Several prominent research-based theories and models, which have provided significant support to modern understanding and practice of health promotion and disease prevention, may offer insights into understanding the causes of current trends in mental health. The World Health Organization's Commission on the Social Determinants of Health (SDH), for example, defined the SDH as "the conditions in which people are born, grow, live, work and age" as the fundamental drivers of public health.¹⁴ Thus, when observing emerging trends in population health, it is important to look at the underlying conditions that may drive the changes. The eminent epidemiologist Geoffrey Rose stressed that the determinants of individual cases and the determinants of incidence rates are two different issues. The second seeks the causes of changing incidence of health problems in the population, the question we focus on here.¹⁵ This research argues that political, economic, historical, and cultural trends in Western societies may have affected mental health by influencing changes in social living conditions. Neoliberalism has been the dominating political ideology in our part of the world since the 1980s. Economic growth has been the main priority of the neoliberal agenda, together with the deregulation of economies, forcing open national and international markets to trade.¹⁶ The rapidly growing global unregulated information technology sector collects and mines enormous amounts of data on individuals. The term *dataism* is used to describe the mindset or philosophy created by this trend. Recently, the term has been expanded to describe what the historian Yuval Noah Harari has called an emerging ideology or even a new form of religion.¹⁷ The increase in global interactions has caused a growth in international trade and the exchange of ideas and culture. Consumerism, the increasing polarization due to so-called technologically produced "echo-chambers" in digitally mediated spaces of social interaction are but a few of the trends influencing these developments.¹⁸ Taking selfies, and along with that, improving our image for public consumption have become regular in younger generations.¹⁹

Driven by these societal and technological trends, the use of Internet began to increase in the early 2000s, and smartphones from 2010. Social media also became more popular after 2010. These trends may have had a significant impact on human behavior, especially among adolescents and young adults. In several large studies, heavy users of such technologies are more likely to be depressed²⁰ or have lower levels of well-being.²¹ Declines in face-to-face social interaction among

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3 adolescents may also impact even non-users of digital media, increasing the need for social
4 assurance and reducing opportunities for in-person social interaction. However, need for social
5 assurance fueled by excessive smartphone use is often not gratified, and eventually leads to greater
6 loneliness.²² Some evidence suggests that increased time spent using these technologies and, more
7 generally, exposure to the evolving modern technological environment may be causes of the sudden
8 increase in depression since 2010.⁹ Furthermore, research on adolescents in Norway has associated
9 psychiatric problems with sleep quality problems, which are exacerbated by the use of social media
10 and computer gaming among adolescents.²³⁻²⁵ In addition, higher academic pressure following the
11 dominant political preoccupation with competition influencing educational programs may also have
12 increased mental distress among adolescents and students.^{26,27}

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16 Based on an understanding of the significant implications of these observed emerging societal
17 trends, the aim of this paper was to examine the parallel changes in mental health among
18 adolescents and adults in a Norwegian population over the three last decades.
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20 21 22 23 Methods

24 The data were taken from three different waves in the Trøndelag Health Study (HUNT), Young-
25 HUNT1 and HUNT2 (1995-97), Young-HUNT3 and HUNT3 (2006-08) and Young-HUNT4 and HUNT4
26 (2017-19)(figure 1).²⁸ The invited participants were the total population in the Nord-Trøndelag
27 County area aged 13-19 years (Young-HUNT) and 20+ years (HUNT).²⁹ The numbers and attendance
28 rates are shown in figure 1. The samples ranged from 8980 to 8066 adolescent participants and from
29 62 444 to 48 362 adult participants.
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34 **Figure 1.** Data collected in the HUNT Study, Norway. Number of participants and attendance rates.²⁸
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39 Data from the different decades were stratified by age and sex. In the Young-HUNT surveys, we
40 applied the Hopkins Symptom Checklist-5 (SCL-5). Hopkins Symptom Checklist-25 (SCL-25) is a
41 widely applied self-report measure of depression and anxiety symptoms. Compared with the SCL-25,
42 the short form model fit is good and correlations with established measures demonstrate
43 convergent validity.^{30,31} For adults, we applied the Hospital Anxiety and Depression Scale (HADS). The
44 HADS is a brief 14-item self-report questionnaire, consisting of seven items for the anxiety subscale
45 (HADS-A) and seven for the depression subscale (HADS-D), each scored on a Likert-scale from 0 (no
46 symptoms) to 3 (symptoms maximally present). For this study, valid ratings of the HADS-D and
47 HADS-A were defined as at least five completed items on both subscales. The score of those who
48 filled in five or six items was based on the sum of completed items multiplied with 7/5 or 7/6,
49 respectively. We used the conventional cut-off threshold of 8 for the HADS subscales. This cut off
50 value is found to provide optimal sensitivity and specificity (about 0.80) and a good correlation with
51 the case of clinical depression based on DSM-III and ICD-8/9 diagnostic criteria [34]. HADS is found
52 to perform well in assessing the symptom severity and case categorization of anxiety and depressive
53 disorders in the general population and in somatic, psychiatric and primary care patients.³²
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58 Patient and public involvement

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Public stakeholders and patient organizations have been involved in the planning of all HUNT Surveys. No patients were involved in the design or implementation of this specific study. As the study used previously collected data, we did not ask patients or the public to assess the burden of participation. Public stakeholders and patient organizations are involved in dissemination of results from the HUNT Study.

Results

The percentage of adolescents screening positive for anxiety and depression nearly doubled between 1995-97 and 2017-19, from 15.3% to 29.8%, with most of the increase occurring between 2006-08 and 2017-19 (see Table 1).

Table 1. Characteristics for the sample aged 13-19 years. The Young-HUNT Study.²⁹

		Young HUNT1 1995-97		Young HUNT3 2006-08		Young HUNT4 2017-19	
		N	%	N	%	N	%
Age	13-19 y	8980	100	8199	100	8066	100
Sex							
	Girls	4463	49.7	4128	50.4	4106	50.9
	Boys	4517	50.3	4071	49.6	3960	49.1
SCL-5							
	Low	7412	82.5	6441	78.6	5410	67.1
	High	1372	15.3	1520	18.5	2404	29.8
	Missing	196	2.2	238	2.9	252	3.1
Total		8980	100	8199	100	8066	100

The percentage of adults screening positive for depression declined from 9.4% in 1995-97 to 6.7% in 2017-19, and the percentage screening positive for anxiety increased from 12.4% in 1995-97 to 13.4% in 2017-19 (see Table 2).

Table 2. Characteristics for the sample aged 20-79 years. The HUNT Study.²⁸

		HUNT2 (1995-97)		HUNT3 (2006-08)		HUNT4 (2017-19)	
		N	(%)	N	(%)	N	(%)
Age groups							
	20-29 y	9111	(14.6)	4511	(9.3)	6428	(12.3)
	30-39 y	11630	(18.6)	6859	(14.2)	6755	(12.9)
	40-49 y	13603	(21.8)	10012	(20.7)	9002	(17.2)
	50-59 y	11058	(17.7)	11425	(23.6)	10761	(20.5)

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	60-69 y	9048 (14.5)	9801 (20.3)	11186 (21.3)
	70-79 y	7994 (12.8)	5754 (11.9)	8310 (15.9)
Sex				
	Females	32991 (52.8)	26316 (54.4)	28488 (54.3)
	Males	29453 (47.2)	22046 (45.6)	23954 (45.7)
HADS Depression				
	Low	51049 (81.8)	34301 (70.9)	35271 (67.3)
	High	5855 (9.4)	3453 (7.1)	3505 (6.7)
	Missing	5540 (8.9)	10608 (21.9)	13666 (26.1)
HADS Anxiety				
	Low	44462 (71.2)	32192 (66.6)	31594 (60.3)
	High	7736 (12.4)	5387 (11.1)	7004 (13.4)
	Missing	10246 (16.4)	10783 (22.3)	13844 (26.4)
Total		62444 (100)	48362 (100)	52442 (100)

Table 3 shows the trends in prevalence (%) and 95 % confidence interval (CI) for symptoms of poor mental health by age group and sex. Among adolescents, the prevalence of mental health symptoms above the recommended cut-off on the SCL-5 scale³¹ was 10.2% for boys and 21.1% for girls in the 1990s. In the latest survey (2017-19), the prevalence had changed to 16.5% for boys and 44.4% for girls, with a particularly strong change in the last ten years for girls (figure 2).

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Table 3. Prevalence (%) and 95 per cent confidence interval (95% CI) for symptoms of poor mental health (HSCL-5 >2.0) by age group and sex. The HUNT Study, Norway.

Adolescents		Young-HUNT1 1995-97		Young-HUNT3 2006-08		Young-HUNT 4 2017-19		P-value for trend
		Prevalence	95% CI	Prevalence	95% CI	Prevalence	95% CI	
HSCL-5								
Girls	13-19	21.1	(19.9- 22.3)	27.3	(26.0- 28.7)	44.4	(42.8- 45.9)	0.000
Boys	13-19	10.2	(9.3- 11.1)	10.6	(9.7- 11.6)	16.5	(15.4- 17.7)	0.000
Adults		HUNT2		HUNT3		HUNT4		
HADS depression								
Females	20-29	4.2	(3.7 - 4.8)	4.6	(3.7 - 5.7)	10.7	(9.5 - 12.0)	0.000
	30-39	6.9	(6.3 - 7.6)	6.3	(5.5 - 7.2)	8.9	(7.9 - 10.1)	0.004
	40-49	9.3	(8.6 - 10.0)	7.7	(6.9 - 8.5)	9.0	(8.2 - 10.0)	0.377
	50-59	12.3	(11.5 - 13.3)	9.0	(8.3 - 9.9)	8.4	(7.7 - 9.3)	0.000
	60-69	14.2	(13.2 - 15.3)	8.8	(8.0 - 9.7)	7.4	(6.7 - 8.2)	0.000
	70-79	17.5	(16.3 - 18.9)	12.6	(11.4 - 14.0)	7.6	(6.8 - 8.5)	0.000
Males	20-29	3.9	(3.3 - 4.5)	5.8	(4.5 - 7.4)	10.2	(8.7 - 11.9)	0.000
	30-39	6.9	(6.2 - 7.6)	7.3	(6.2 - 8.6)	11.6	(10.2 - 13.2)	0.000
	40-49	10.4	(9.7 - 11.2)	9.0	(8.0 - 10.0)	10.2	(9.0 - 11.4)	0.358
	50-59	13.6	(12.7 - 14.6)	10.5	(9.6 - 11.4)	9.4	(8.5 - 10.4)	0.000
	60-69	13.9	(12.8 - 15.0)	11.1	(10.2 - 12.1)	8.4	(7.6 - 9.3)	0.000
	70-79	16.8	(15.4 - 18.2)	13.7	(12.4 - 15.2)	10.5	(9.5 - 11.6)	0.000
HADS anxiety								
Females	20-29	15.5	(14.4 - 16.5)	19.1	(17.4 - 21.0)	32.0	(30.1 - 33.9)	0.000
	30-39	17.1	(16.1 - 18.1)	17.8	(16.5 - 19.2)	26.7	(25.1 - 28.4)	0.000
	40-49	17.9	(17.0 - 18.9)	17.1	(16.0 - 18.2)	22.1	(20.8 - 23.4)	0.000
	50-59	18.6	(17.5 - 19.8)	18.0	(17.0 - 19.1)	20.4	(19.3 - 21.6)	0.028
	60-69	18.0	(16.7 - 19.3)	16.4	(15.4 - 17.6)	17.9	(16.8 - 19.0)	0.896
	70-79	17.2	(15.7 - 18.8)	17.2	(15.8 - 18.8)	16.2	(15.0 - 17.4)	0.290
Males	20-29	11.9	(10.9 - 13.0)	12.0	(10.2 - 14.2)	19.0	(17.0 - 21.2)	0.000
	30-39	12.9	(12.0 - 13.9)	11.4	(10.0 - 12.9)	18.8	(17.0 - 20.7)	0.000
	40-49	14.0	(13.2 - 15.0)	12.5	(11.4 - 13.7)	16.5	(15.1 - 18.0)	0.030
	50-59	12.5	(11.6 - 13.5)	11.7	(10.8 - 12.7)	15.2	(14.0 - 16.4)	0.001
	60-69	9.2	(8.3 - 10.2)	8.5	(7.6 - 9.4)	11.0	(10.1 - 12.0)	0.004
	70-79	9.4	(8.2 - 10.6)	6.5	(5.6 - 7.6)	8.4	(7.5 - 9.4)	0.325

Figure 2. Prevalence (%) of mental health symptoms measured with SCL-5 (cut-off ≥ 2), from three decades of adolescents in the Young-HUNT Study.

For adults, table 3 shows that an increasing prevalence for depressive symptoms above cut-off with age was observed in both sexes, from around four percent among young adults 20-29 years and around 17% among older people 70-79 years in 1995-97 (figure 3). In contrast to this, the highest prevalence among young women (10.7%), and the lowest among the elderly aged 70-79 (7.6%) were observed in the last survey (2017-19) (figure 3).

Figure 3. Prevalence (%) of depression symptoms measured with HADS-D (cut-off ≥ 8) from three decades, the HUNT Study.

The prevalence of anxiety symptoms above cut-off measured with by HADS-A was similar in all age groups in 1995-97 (table 3); around 10% for men and 17% for women. In the last survey, we observed a markedly higher prevalence of anxiety symptoms for both genders for participants aged 20-39 years (figure 4).

Figure 4. Prevalence (%) of anxiety symptoms measured with HADS-A (cut-off ≥ 8) from three decades, the HUNT Study.

The negative trends among young adults and the positive trends among older participants shown in figures 3 and 4 were statistically significant in almost all groups (appendix table 1).

Discussion

Results from the large Norwegian population-based HUNT Study of more than 170,000 people showed large increases in the prevalence of mental distress among adolescents and young adults since the 1990s, especially between 2006-08 and 2017-19. These increases were largest among young women, though there were also increases among young men. In contrast, among older adults depression rates declined and anxiety symptoms remained largely unchanged.

Possible reasons for change

To determine the societal causes behind public health trends are challenging. One possibility is higher academic pressure following the dominant neoliberal political preoccupation with competition.²⁷ When young people's sense of self-worth is dependent on what they achieve in school, it can also lead to anxiety and depression.²⁶ Another substantial change in Western societies over this time-period has been in technology use. The tech industry's strong influence on young people's behavior based on deliberately manipulative and exploitive strategies³³ may be an important driver of the observed trends among young people in our data.⁹ Heavy users of technology, for example, are twice as likely as light users to be depressed or report lower levels of well-being.⁹ Other detrimental effects from the overuse of online technologies may include an increase in the prevalence of loneliness seen after 2012^{22,34} and reduced hours of sleep among adolescents.^{23,24} Some have questioned the suggestion that increased time spent on social media is the leading cause of increasing mental stress among young people, with individual data revealing only a weak association between time use and mental health in a longitudinal study.³⁵ However, associations at the individual level may be different from the group-level associations we examine here; even non-users of technology may be impacted by the changes in social interaction caused by technology use.⁹ Thus, it becomes necessary to look further into the political, historical and cultural context in which these behavioral changes unfold.^{15,36}

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3 Among older segments of the population, who spend less time using online technologies, we see no
4 similar increase in mental health issues over the study period. In fact, our results highlight rather the
5 opposite – a decrease in mental health related issues. Such trends have also been observed in other
6 populations.¹² Older people in Norway benefit from good living conditions with financial security in a
7 generous welfare state and good prospects of a high life expectancy. Compared to younger adults,
8 older individuals may also be more skilled at emotional regulation and complex social decision-
9 making, and better able to cope with the stress of technological developments.^{12 37} Hence, the
10 youngest generation, iGen/GenZ, is affected most negatively by the changes in technology.³⁸ Other
11 important social developments such as the climate threat, developments in a globalized labor
12 market, generally weaker global economic growth and increase in social inequalities in many
13 western economies, including Norway³⁹, may also affect younger people more as they are less likely
14 to be established and secure.

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18 However, the rapid and almost uncontrolled development in the information technology industry,
19 has taken place without notable political concern in Norway or other western countries, in line with
20 dominating neoliberal political ideology.¹⁶ This development is saturated with paradoxes. We have
21 never had greater access to information, nevertheless being so poorly informed. It has never been
22 easier to contact friends or family, yet the trend is to remain lonely and psychologically stressed. We
23 are not required to abandon technology altogether, however, it is imperative that the consequences
24 of these technological developments are to be taken seriously; otherwise we may be at risk of
25 abandoning an entire generation of young people. Importantly, there is an emerging discussion
26 concerning why it is necessary to respond to commercial⁴⁰ and corporate determinants of health,
27 reflecting in part a growing appreciation of their enormous power.⁴¹

32 33 *Strengths*

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35 The HUNT Study collect data from a total population at approximately ten years intervals, enabling
36 studies of health changes in the population over time.^{28 29} The invitation/sampling of participants,
37 and methods for measuring mental health, have been conducted using the same methods and
38 instruments in all three surveys. Large sample sizes have ensured reliable estimates. Health trends in
39 the county follow both national⁴² and international western health trends closely.⁴³ The population
40 is stable and relatively homogenous with a low net migration. As part of a national Nordic welfare
41 state, the population recruited is part of a country with a universal public health service and a school
42 system where almost everyone attends the same local schools.

48 49 *Weaknesses*

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51 Our survey data covered approximately 70% of the total adolescent population and 70% to 54% of
52 the total adult population (as the result of a decrease in participation rate from HUNT2 to HUNT3
53 among adults). Non-response analyzes for adult participants showed that those who choose not to
54 participate generally have a higher mortality rate, slightly higher prevalence of chronic illness, and
55 lower social status than participants.⁴⁴ We assess this potential selection bias to influence the
56 observed trends.

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58 Additionally, it is possible to assume that the results are based on changes in socio-cultural and
59 behavioral attitudes towards depression, anxiety, and mental health in general. In recent years,
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3 mental health has received increased attention in the Norwegian society. As a result, it may have
4 become easier for participants to report mental health concerns and express emotion in
5 questionnaires. Therefore, a desire by the participant to provide socially desirable responses may
6 have affected the results. For the adult participants, we used another tool, HADS, which showed the
7 exact same trend for participants aged 20-39 years as the SCL-5 in adolescents. This supports the
8 validity of the findings. In addition, results are supported by data from the Norwegian health services
9 and prescription databases, clearly demonstrating increasing numbers of individuals either referred
10 for, or in need of, treatment for mental health illness among young people.⁴⁵ The increase in
11 reported mental health issues demonstrated in our data, is also accompanied by an increasing
12 number of adolescents in the general population referred to mental health services,⁴⁶ an increased
13 use of psychotropic drugs in age groups reporting increasing symptoms,⁴⁷ and an increasing number
14 of young adults in need of social welfare.⁴⁸
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20 *Relevance*

21
22 Our results are in line with results suggesting negative trends in mental health observed among
23 adolescents and young adults internationally⁸ and, more specifically, in the USA.⁹ The data are of
24 great interest to public health policy. The undesirable trend has affected many young people and
25 affected everyday life substantially for large groups in Norway. Based on earlier findings from the
26 HUNT Study, there is reason to fear that increasing mental health problems may contribute to an
27 increasing incidence of work-related incapacity in Norway now and in the years to come.^{6 49}
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32 *Need for action*

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34 Based on what is outlined in this paper, there is every reason to consider political measures to
35 protect the young part of the population against increasing mental health distress. With experience
36 from population-based public health measures, there is reason to believe that increased regulation
37 of the tech industry, which has enjoyed relatively few restrictions for decades, will be extremely
38 important when moving forward. Governments and individuals could challenge their role in defining
39 the dominant narrative, setting the rules by which trade operates, commodifying knowledge and
40 undermining political, social, and economic rights in our society.⁴¹ Relevant measures could be, but
41 are not limited to, for example an age limit for use of social media and online computer gaming,
42 creating increased accountability for the content published by technology companies and their
43 platforms, regulations to restrict addictive elements of different software, and taxation of the
44 industry to obtain funding for relevant public health initiatives. However, of greatest concern is
45 restructuring and regulating the entire economic business model on which many of these tech giants
46 not only depend on for their enormously powerful profits but have also had a central role in
47 developing for the deliberate manipulation and exploitation of its most vulnerable users. Such
48 measures would undoubtedly increase in effectiveness through systematic international
49 cooperation. In addition, the academic pressure following the dominant political ideology, is
50 another issue that needs to be addressed.³⁶
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57 *Conclusion*

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59 The data from the HUNT Study in Norway indicate a strong and worrying increase in mental health
60 symptoms among adolescents and young adults, and the opposite trend among the elderly. This

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3 trend is likely related to marked behavioral changes in adolescents and young adults driven by
4 neoliberal policy, globalization and an expanding tech industry.¹⁷ It is urgently important that the
5 health authorities now see the need to implement political measures to reverse the negative trend
6 concerning young people. The mental health of young generations must not be sacrificed on the
7 neoliberal altar.
8
9

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16 Public Health.
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20 21 22 Footnotes

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24 drafted the manuscript. All authors contributed to the interpretation of the results and critically
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26 responsibility for the work and/or the conduct of the study, had access to the data, and controlled
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44

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50

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54
55

56 Data sharing: Data from the Trøndelag Health Study (HUNT) is available upon reasonable request to
57 the HUNT data access committee (hunt@medisin.ntnu.no). The HUNT data access information
58 (www.ntnu.edu/hunt/data) describes in detail the policy about data availability.
59
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Transparency: The lead author (SK) affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and any discrepancies from the study as planned have been explained.

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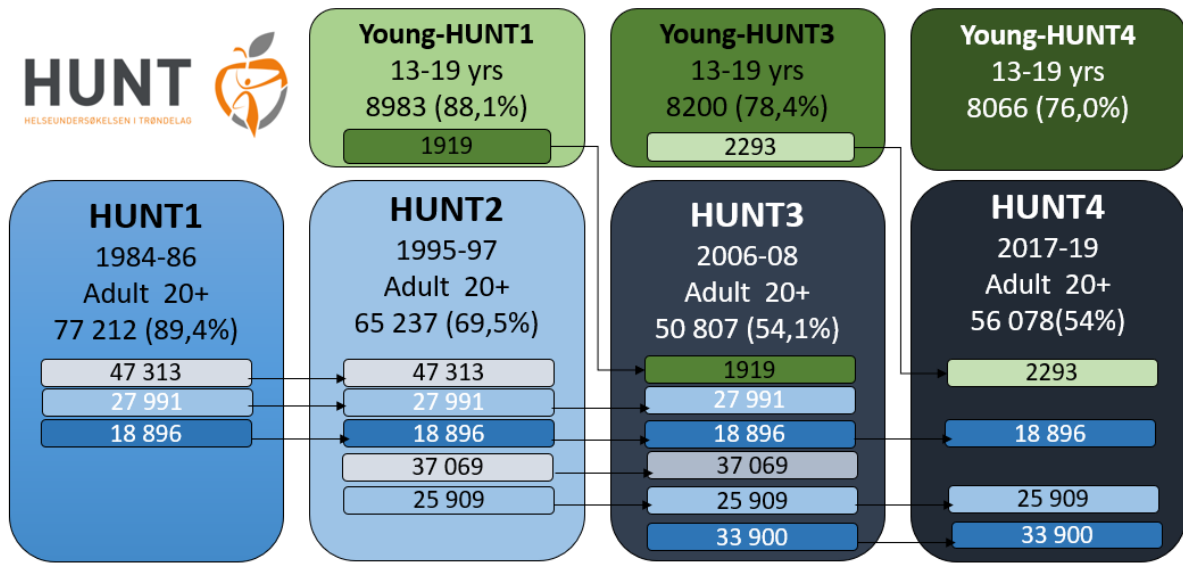
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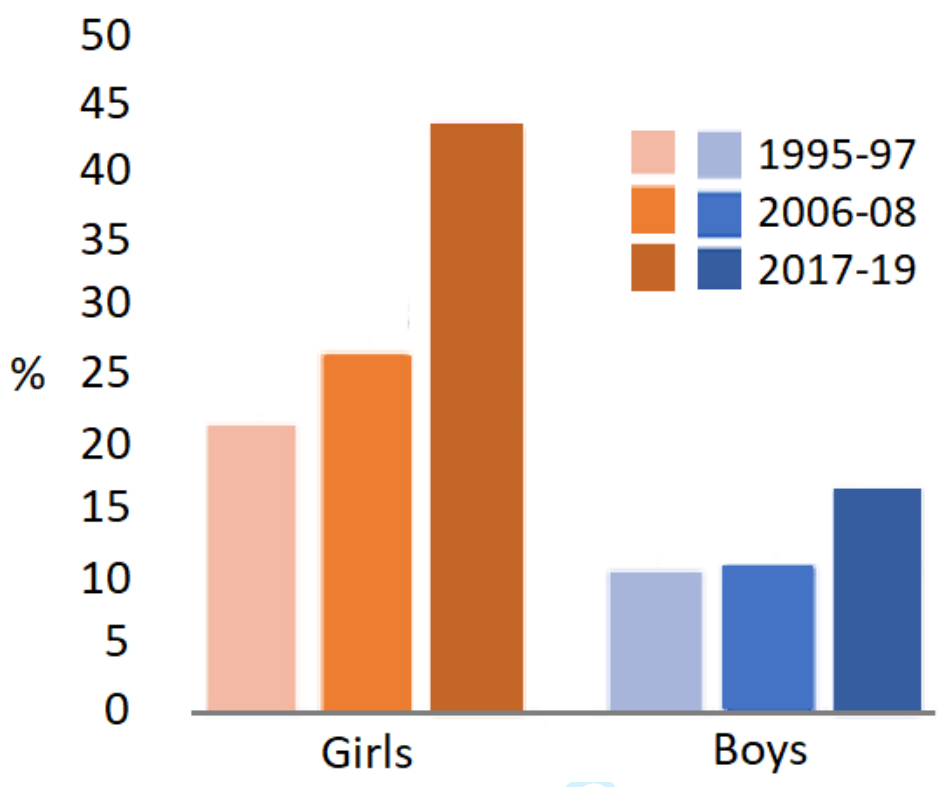
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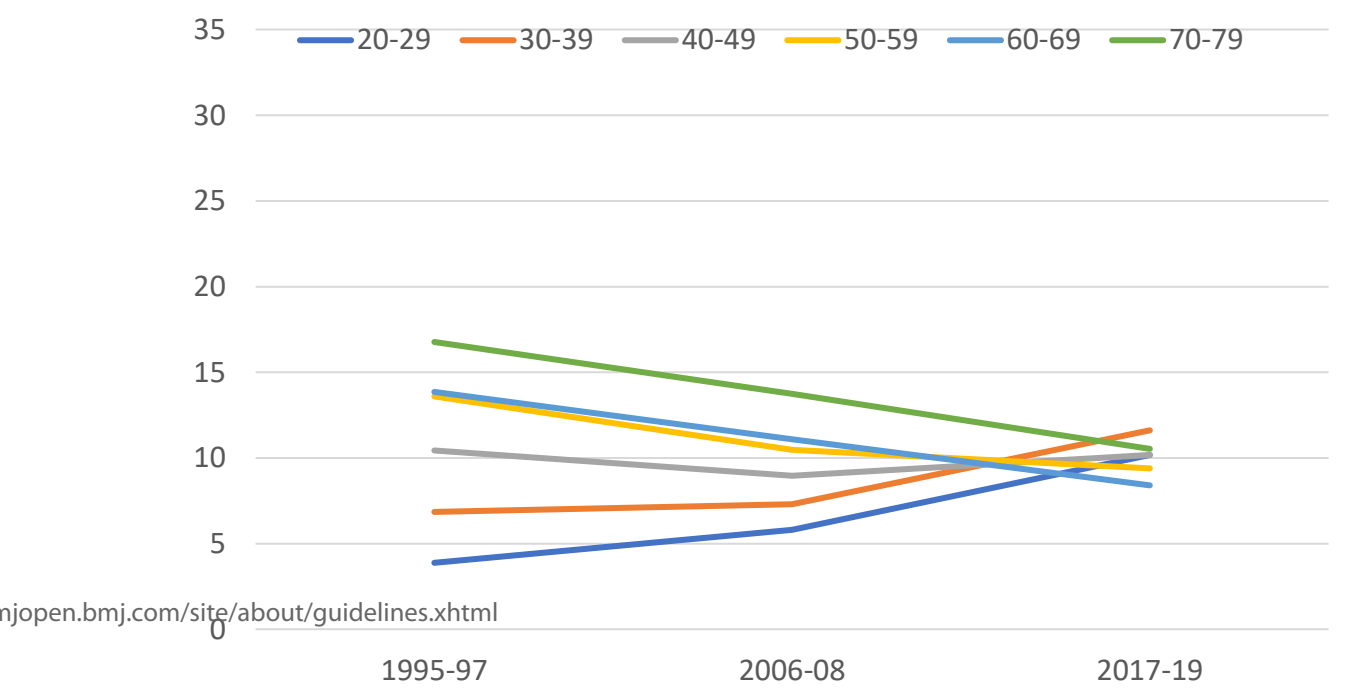
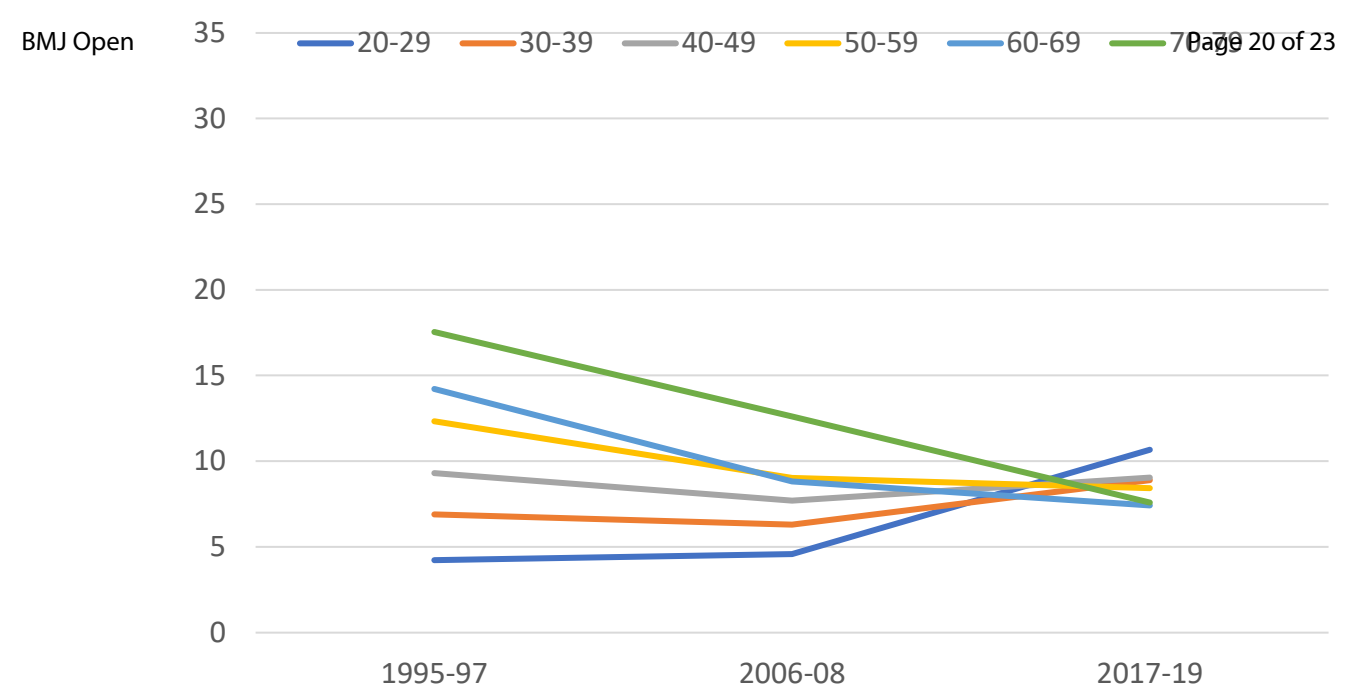
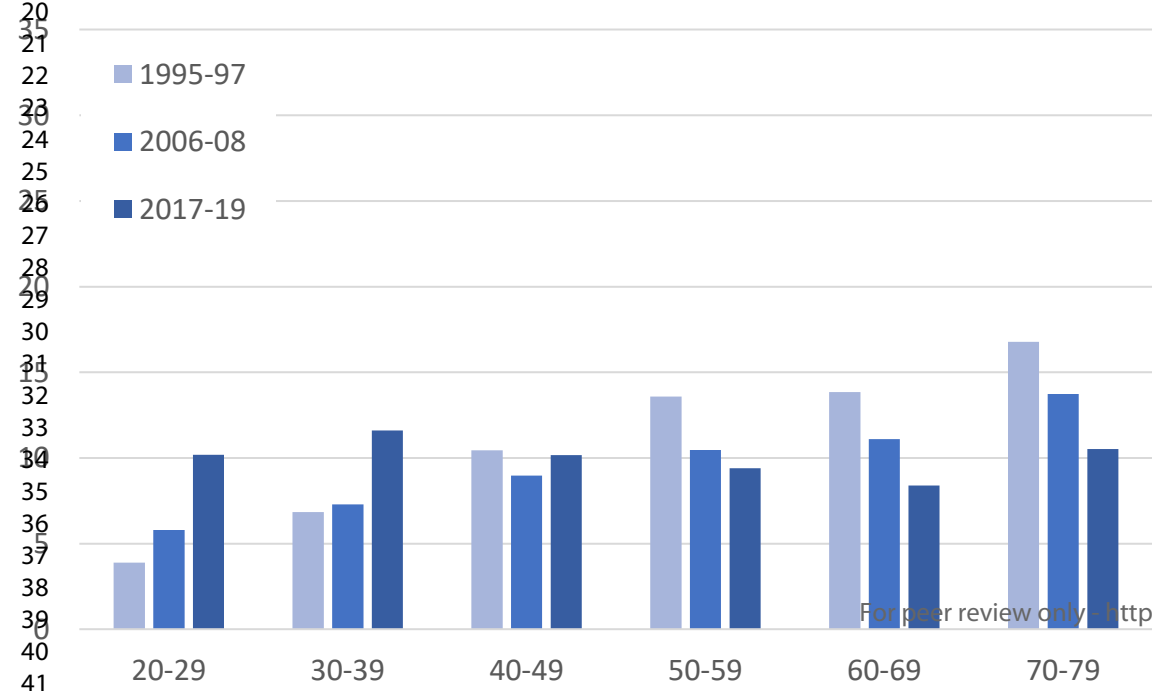
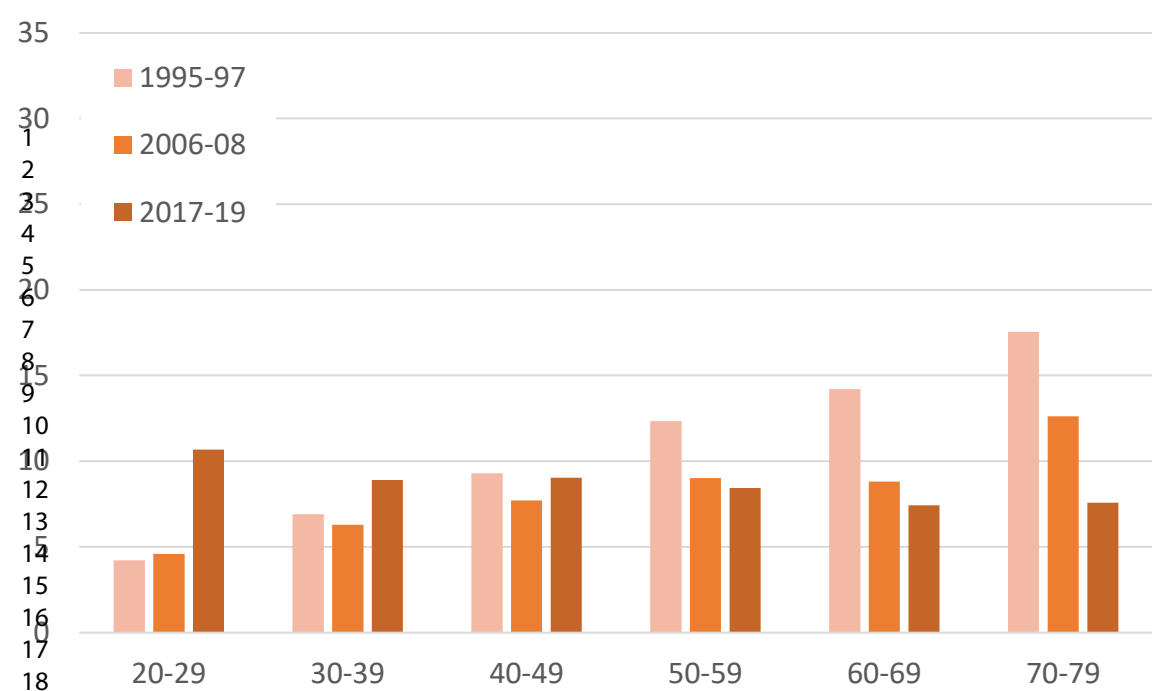


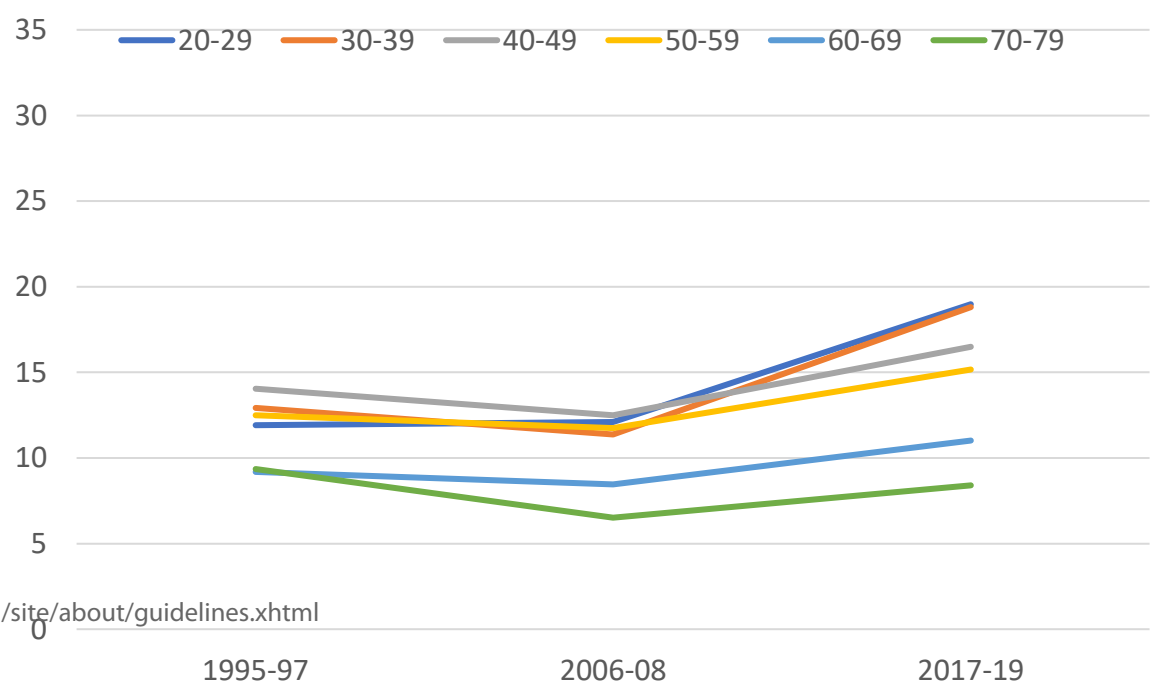
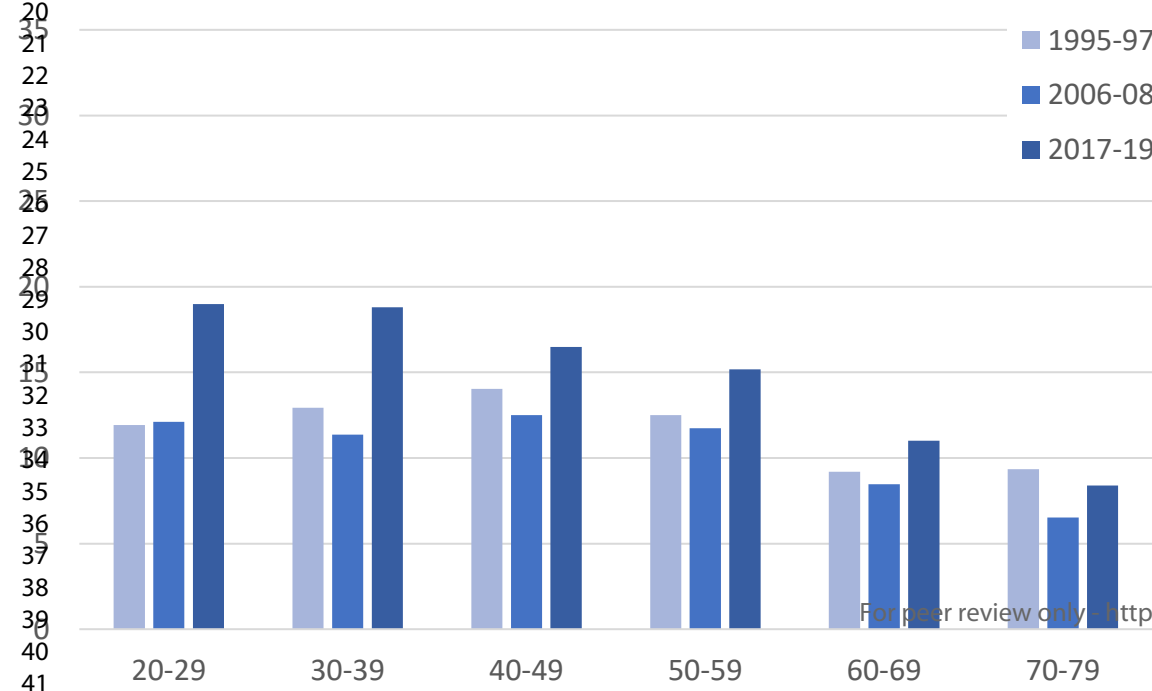
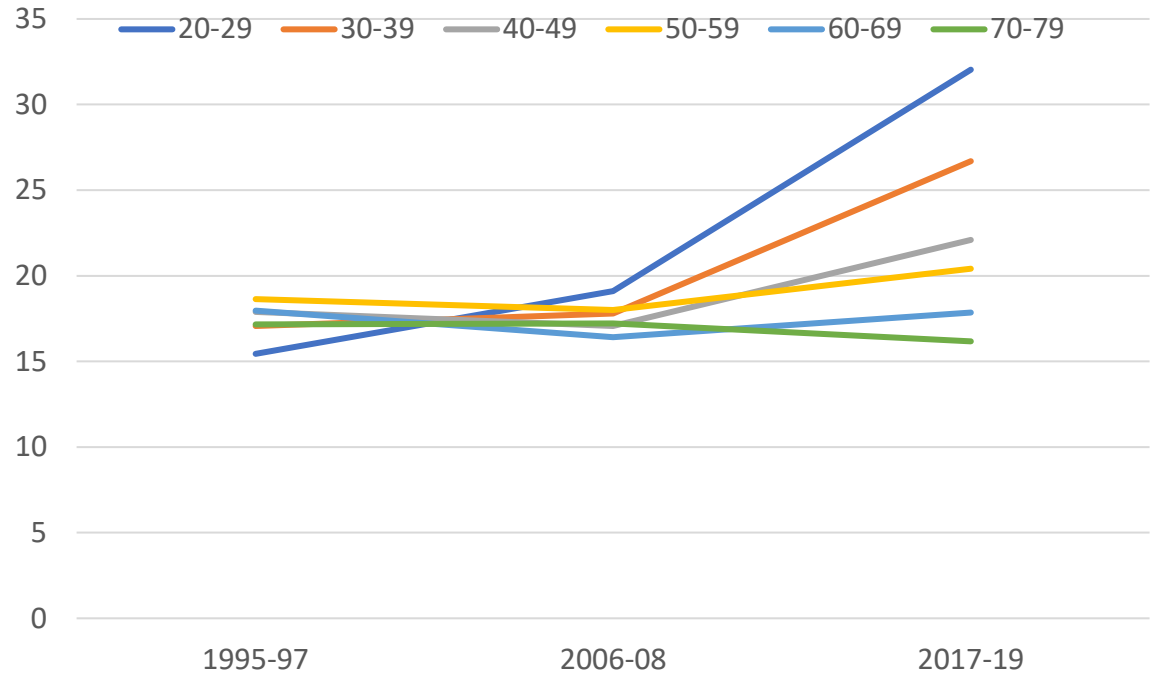
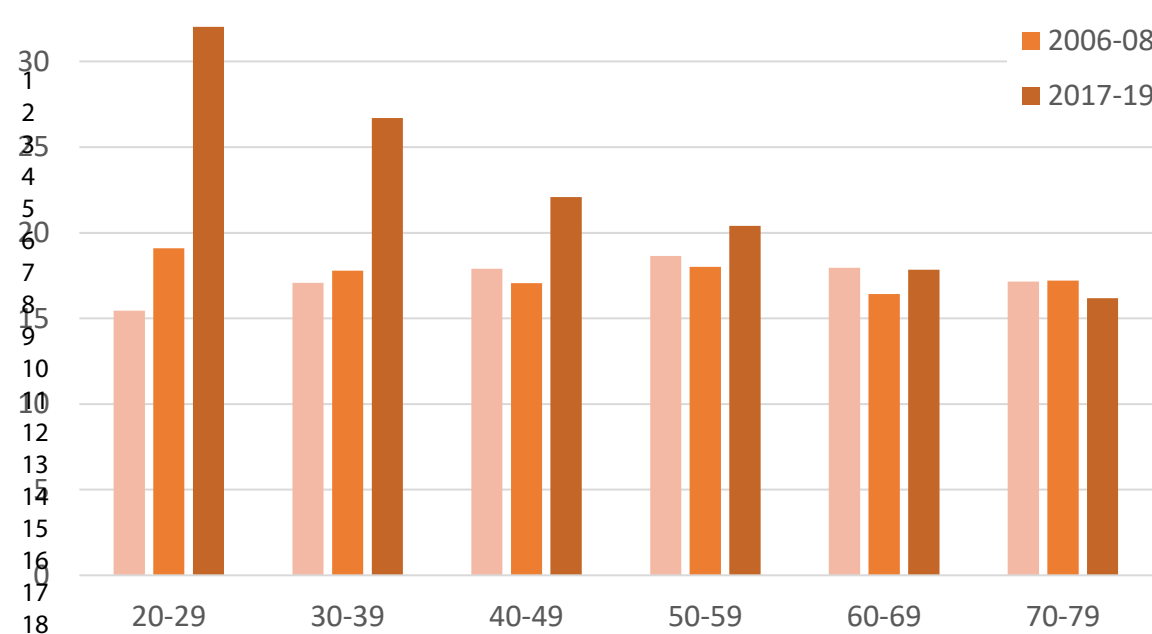
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Appendix table 1

Appendix table 1. Prevalence (%) and 95 percent confidence interval (95% CI) for symptoms of poor mental health by age group and sex.

		HUNT2		HUNT3		HUNT4		P-value for trend
		Prevalence	95% CI	Prevalence	95% CI	Prevalence	95% CI	
HADS depression								
Women	20-29	4.2	(3.7 - 4.8)	4.6	(3.7 - 5.7)	10.7	(9.5 - 12.0)	0.000
	30-39	6.9	(6.3 - 7.6)	6.3	(5.5 - 7.2)	8.9	(7.9 - 10.1)	0.004
	40-49	9.3	(8.6 - 10.0)	7.7	(6.9 - 8.5)	9.0	(8.2 - 10.0)	0.377
	50-59	12.3	(11.5 - 13.3)	9.0	(8.3 - 9.9)	8.4	(7.7 - 9.3)	0.000
	60-69	14.2	(13.2 - 15.3)	8.8	(8.0 - 9.7)	7.4	(6.7 - 8.2)	0.000
	70-79	17.5	(16.3 - 18.9)	12.6	(11.4 - 14.0)	7.6	(6.8 - 8.5)	0.000
Men	20-29	3.9	(3.3 - 4.5)	5.8	(4.5 - 7.4)	10.2	(8.7 - 11.9)	0.000
	30-39	6.9	(6.2 - 7.6)	7.3	(6.2 - 8.6)	11.6	(10.2 - 13.2)	0.000
	40-49	10.4	(9.7 - 11.2)	9.0	(8.0 - 10.0)	10.2	(9.0 - 11.4)	0.358
	50-59	13.6	(12.7 - 14.6)	10.5	(9.6 - 11.4)	9.4	(8.5 - 10.4)	0.000
	60-69	13.9	(12.8 - 15.0)	11.1	(10.2 - 12.1)	8.4	(7.6 - 9.3)	0.000
	70-79	16.8	(15.4 - 18.2)	13.7	(12.4 - 15.2)	10.5	(9.5 - 11.6)	0.000
HADS anxiety								
Women	20-29	15.5	(14.4 - 16.5)	19.1	(17.4 - 21.0)	32.0	(30.1 - 33.9)	0.000
	30-39	17.1	(16.1 - 18.1)	17.8	(16.5 - 19.2)	26.7	(25.1 - 28.4)	0.000
	40-49	17.9	(17.0 - 18.9)	17.1	(16.0 - 18.2)	22.1	(20.8 - 23.4)	0.000
	50-59	18.6	(17.5 - 19.8)	18.0	(17.0 - 19.1)	20.4	(19.3 - 21.6)	0.028
	60-69	18.0	(16.7 - 19.3)	16.4	(15.4 - 17.6)	17.9	(16.8 - 19.0)	0.896
	70-79	17.2	(15.7 - 18.8)	17.2	(15.8 - 18.8)	16.2	(15.0 - 17.4)	0.290
Men	20-29	11.9	(10.9 - 13.0)	12.0	(10.2 - 14.2)	19.0	(17.0 - 21.2)	0.000
	30-39	12.9	(12.0 - 13.9)	11.4	(10.0 - 12.9)	18.8	(17.0 - 20.7)	0.000
	40-49	14.0	(13.2 - 15.0)	12.5	(11.4 - 13.7)	16.5	(15.1 - 18.0)	0.030
	50-59	12.5	(11.6 - 13.5)	11.7	(10.8 - 12.7)	15.2	(14.0 - 16.4)	0.001
	60-69	9.2	(8.3 - 10.2)	8.5	(7.6 - 9.4)	11.0	(10.1 - 12.0)	0.004
	70-79	9.4	(8.2 - 10.6)	6.5	(5.6 - 7.6)	8.4	(7.5 - 9.4)	0.325

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

The following recommendations were followed if applicable for the manuscript: Paradoxical trends in mental health in the society and the root causes of increased mental health problems among young people. The HUNT Study, Norway.

	Item No	Recommendation	Page in manus.
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4-5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4-5
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4-5
Bias	9	Describe any efforts to address potential sources of bias	11
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	4
		(b) Describe any methods used to examine subgroups and interactions	4
		(c) Explain how missing data were addressed	5-6
		(d) If applicable, describe analytical methods taking account of sampling strategy	Na
		(e) Describe any sensitivity analyses	Na
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	4
		(b) Give reasons for non-participation at each stage	4
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	5
		(b) Indicate number of participants with missing data for each variable of interest	5

Outcome data	15*	Report numbers of outcome events or summary measures	5
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6-9
		(b) Report category boundaries when continuous variables were categorized	5-9
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Na
Discussion			
Key results	18	Summarise key results with reference to study objectives	9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9-10, 11-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	10
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Divergent decennial trends in mental health according to age. Which underlying causes may drive the increases in mental health issues for young people? Repeated cross-sectional population-based surveys from the HUNT Study, Norway

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Secondary Subject Heading:	Mental health, Epidemiology, Health policy
Keywords:	MENTAL HEALTH, PUBLIC HEALTH, EPIDEMIOLOGY, SOCIAL MEDICINE

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Divergent decennial trends in mental health according to age.

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Which underlying causes may drive the increases in mental

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health issues for young people? Repeated cross-sectional

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population-based surveys from the HUNT Study, Norway

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Steinar Krokstad (000-0002-2932-6675), Daniel Albert Weiss, Morten Austheim Krokstad, Vegar Rangul, Kirsti Kvaløy, Jo Magne Ingul, Ottar Bjerkeset, Jean Marie Twenge, Erik Reidar Sund.

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25 10

26
27 11

Steinar Krokstad, professor, HUNT Research Centre, Department of Public Health and Nursing, Norwegian University of Science and Technology, 7600 Levanger, Norway.

28
29 12

30
31 13

Daniel Albert Weiss, associate professor, Nord University, Faculty of Social Sciences, Universitetsalléen 11, 8026 Bodø, Norway.

32
33 14

34
35 15

Morten Austheim Krokstad, PhD Fellow, Faculty of Health Sciences and Nursing, Nord University, 7600 Levanger, Norway.

36
37 16

38
39 17

Vegar Rangul, associate professor, HUNT Research Centre, Department of Public Health and Nursing, Norwegian University of Science and Technology, 7600 Levanger, Norway.

40
41 18

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43 19

Kirsti Kvaløy, professor, HUNT Research Centre, Department of Public Health and Nursing, Norwegian University of Science and Technology, 7600 Levanger, Norway.

44
45 20

46
47 21

Jo Magne Ingul, psychologist, Levanger Hospital, Nord-Trøndelag Hospital Trust, 7600 Levanger, Norway.

48
49 22

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51 23

Ottar Bjerkeset, professor, Faculty of Health Sciences and Nursing, Nord University, 7600 Levanger, Norway.

52
53 24

54
55 25

Jean Marie Twenge, professor, Department of Psychology, College of Sciences, San Diego State University, San Diego, CA 92182-4611, USA.

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Erik Reidar Sund, senior researcher, HUNT Research Centre, Department of Public Health and Nursing, Norwegian University of Science and Technology, 7600 Levanger, Norway.

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Correspondence to: Steinar Krokstad (000-0002-2932-6675) steinar.krokstad@ntnu.no

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4 325
6 337
8 34 **Abstract**

9 35 **Objectives.** Public health trends are formed by political, economic, historical, and cultural factors in
10 36 society. The aim of this paper was to describe overall changes in mental health among adolescents
11 37 and adults in a Norwegian population over the three last decades and offer some potential
12 38 explanations for these changes.

13 39 **Design.** Repeated population-based health surveys to monitor decennial changes.

14 40 **Setting.** Data from three cross-sectional surveys in in 1995-97, 2006-08 and 2017-19 in the
15 41 population-based HUNT Study in Norway were used.

16 42 **Participants.** The general population in a Norwegian County covering participants aged 13 to 79
17 43 years, ranging from 48 000 to 62 000 in each survey.

18 44 **Main outcome measures.** Prevalence estimates of subjective anxiety and depression symptoms
19 45 stratified by age and gender were assessed using the Hopkins Symptom Check-List 5 (HSCL-5) for
20 46 adolescents and the Hospital Anxiety and Depression Scale (HADS) for adults.

21 47 **Results.** Adolescents' and young adults' mental distress increased sharply, especially between 2006-
22 48 08 and 2017-19. However, depressive symptoms instead declined among adults ages 60 and over
23 49 and anxiety symptoms remained largely unchanged in these groups.

24 50 **Conclusions.** Our data from the HUNT Study in Norway indicate a strong increase in mental health
25 51 symptoms among adolescents and young adults that we suggest are related to relevant changes in
26 52 young people's living conditions and behavior, including the increased influence of screen-based
27 53 media.

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30 56

31 57 **Strengths and limitations of this study**

- 32 58 ➤ The HUNT Study is a large general county population health survey repeated every decade since
33 59 the 1980s in Norway, suitable for following trends in public health
- 34 60 ➤ The total population 13+ years are invited to complete the survey
- 35 61 ➤ Identical screening tools for measuring mental symptoms have been used in all three surveys
36 62 covered by this article; Hopkins Symptoms Check List 5 for adolescents and Hospital Anxiety and
37 63 Depression Scale for adults
- 38 64 ➤ Data covered approximately 78% of the total adolescent population and 54% to 70% of the total
39 65 adult population with the risk of selection bias
- 40 66 ➤ Changes in socio-cultural and behavioral attitudes towards depression, anxiety, and mental
41 67 health in general the recent years may have made it easier for participants to report mental
42 68 health concerns and express emotion in questionnaires

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71 Introduction

72 Mental health problems are among the leading causes of disease burden worldwide.^{1,2} Further,
73 mental health issues are primary drivers of disability worldwide, causing over 40 million years of
74 disability in 20 to 29-year-olds.³ Depression alone accounts for more disability-adjusted life years
75 (DALYs) than all other mental disorders together⁴ and is projected to become the leading cause of
76 disability in high-income countries by 2030.⁵ Thus, the public health burden of mood disorders is
77 substantial, with negative effects including functional problems, reduced quality of life, disability,
78 low work productivity, increased mortality, and increased health care utilization.

79 In Norway, estimates of years lived with disability in 2016, display anxiety and depression ranked as
80 number four and seven on the list of the most contributing diseases in the Global Burden of Disease
81 statistics.⁶ Mental disorders are highly prevalent in disability benefit statistics, with awards often
82 granted at younger ages than for other diagnoses. Mental disorders have additionally been shown to
83 be responsible for the most working years lost (33.8%) of any disability.⁷

84 During the last decade, rates of depressive symptoms have increased in several adolescent
85 populations.⁸⁻¹⁰ In the USA, rates of depression, self-harm, and suicide attempts increased
86 substantially in adolescents after 2010.¹¹⁻¹³ On the other hand, data have paradoxically shown an
87 improvement in mental health with age indicating the opposite trend among older people.^{14,15}

88 Several prominent research-based theories and models, which have provided significant support to
89 modern understanding and practice of health promotion and disease prevention, may offer insights
90 into understanding the causes of current trends in mental health. The World Health Organization's
91 Commission on the Social Determinants of Health (SDH), for example, defined the SDH as "the
92 conditions in which people are born, grow, live, work and age" as the fundamental drivers of public
93 health.¹⁶ Thus, when observing emerging trends in population health, it is important to look at the
94 underlying conditions that may drive the changes. The eminent epidemiologist Geoffrey Rose
95 stressed that the determinants of individual cases and the determinants of incidence rates are two
96 different issues. The second seeks the causes of changing incidence of health problems in the
97 population, the question we focus on here.¹⁷ This theory argues that political, economic, historical,
98 and cultural trends in Western societies may have affected mental health by influencing changes in
99 social living conditions. Neoliberalism has been the dominating political ideology in our part of the
100 world since the 1980s. Economic growth has been the main priority of the neoliberal agenda,
101 together with the deregulation of economies, forcing open national and international markets to
102 trade.¹⁸ This has contributed to major changes in the living conditions of groups in societies around
103 the world, including young people. For many, optimism and the belief in economic growth and
104 improved quality of life have been replaced by concerns about climate change, growing social
105 injustice, threats to democracy and the threat of technological developments leading to increased
106 exploitation and potentially magnifying many of these other concerns.¹⁹ These concerns have
107 become particularly visible for young people growing up in many western, developed societies.

108 It has become increasingly apparent that the rapidly growing global unregulated information
109 technology sector collects and mines enormous amounts of data on individuals.²⁰ The term *dataism*
110 is used to describe the mindset or philosophy created by this trend. Recently, the term has been
111 expanded to describe what others, including leading historian Yuval Noah Harari and leading social
112 psychologist Shoshana Zuboff, has called an emerging form of capitalism, ideology, or even a new
113 form of religion.^{20,21} The increase in global interactions has caused a growth in international trade
114 and the exchange of ideas and culture. Consumerism, the increasing polarization due to so-called
115 technologically produced "echo-chambers" in digitally mediated spaces of social interaction are but

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3 116 a few of the trends influencing these developments.²² Taking selfies, and along with that, improving
4 117 our image for public consumption have become regular in younger generations.²³
5
6 118 Driven by these societal and technological trends, the use of the internet began to increase in the
7 119 early 2000s, and smartphones after 2010. Social media also became more popular after 2010. These
8 120 trends may have had a significant impact on human behavior, especially among adolescents and
9 121 young adults. In several large studies, heavy users of such technologies are more likely to be
10 122 depressed^{9 24} or have lower levels of well-being.^{9 25} Similar analyses from HUNT data in Norway have
11 123 shown significant effects between the number of hours of screen time and increased mental health
12 124 issues, particularly strong when this screen time is predominantly the use of social media and
13 125 internet. These effects are significantly strengthened both for girls and for number of hours.²⁶
14 126 Declines in face-to-face social interaction among adolescents may also impact even non-users of
15 127 digital media, increasing the need for social assurance and reducing opportunities for in-person
16 128 social interaction.²⁷ However, need for social assurance fueled by excessive smartphone use is often
17 129 not gratified, and eventually leads to greater loneliness.²⁸ Some evidence suggests that increased
18 130 time spent using these technologies and, more generally, exposure to the evolving modern
19 131 technological environment may be causes of the sudden increase in depression since 2010.¹¹ Girls
20 132 generally demonstrate stronger associations between digital media time and mental health
21 133 indicators than boys, perhaps because social media, used more frequently by girls, is more strongly
22 134 linked to depression than gaming, used more frequently by boys.⁹ Furthermore, research on
23 135 adolescents in Norway has associated psychiatric problems with sleep quality problems, which are
24 136 exacerbated by the use of social media and computer gaming among adolescents.²⁹⁻³¹ In addition,
25 137 higher academic pressure following the dominant political preoccupation with competition
26 138 influencing educational programs may also have increased mental distress among adolescents and
27 139 students.^{32 33} A Norwegian study has shown a clear decline in young people's reporting of happiness
28 140 and life satisfaction in the last ten years. The study showed that increasing concern about the future
29 141 contributed most to the decline. This concern was related to fears of various adverse events, such as
30 142 future job opportunities and one's own financial situation. Other conditions such as dissatisfaction
31 143 with social relationships, health, physical fitness and body also had significance.³⁴
32
33 144 The aim of this paper was to describe the parallel changes in mental health among adolescents and
34 145 adults in a Norwegian population over the three last decades and suggest some potential
35 146 explanations for these changes.
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45 148 Methods

46 149 The data were taken from three different waves in the Trøndelag Health Study (HUNT), Young-
47 150 HUNT1 and HUNT2 (1995-97), Young-HUNT3 and HUNT3 (2006-08) and Young-HUNT4 and HUNT4
48 151 (2017-19)(figure 1).³⁵ The invited participants were the total population in the Nord-Trøndelag
49 152 County area aged 13-19 years (Young-HUNT) and 20+ years (HUNT).³⁶ The numbers and attendance
50 153 rates are shown in figure 1. The samples ranged from 8980 to 8066 adolescent participants and from
51 154 62 444 to 48 362 adult participants.
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56 156 **Figure 1.** Data collected in the HUNT Study, Norway. Number of participants and response rates.^{35 36}
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3 158 Data from the different decades were stratified by age and sex. In the Young-HUNT surveys, we
4 159 applied the Hopkins Symptom Checklist–5 (SCL-5). Hopkins Symptom Checklist–25 (SCL-25) is a
5 160 widely applied self-report measure of depression and anxiety symptoms. Compared with the SCL-25,
6 161 the short form model fit is good and correlations with established measures demonstrate
7 162 convergent validity.^{37 38} Prevalence (%) of mental health symptoms was measured with SCL-5 (cut-off
8 163 > 2). For adults, we applied the Hospital Anxiety and Depression Scale (HADS). The HADS is a brief
9 164 14-item self-report questionnaire, consisting of seven items for the anxiety subscale (HADS-A) and
10 165 seven for the depression subscale (HADS-D), each scored on a Likert-scale from 0 (no symptoms) to 3
11 166 (symptoms maximally present). For this study, valid ratings of the HADS-D and HADS-A were defined
12 167 as at least five completed items on both subscales. The score of those who filled in five or six items
13 168 was based on the sum of completed items multiplied with 7/5 or 7/6, respectively. We used the
14 169 conventional cut-off threshold of ≥ 8 for the HADS subscales. This cut off value is found to provide
15 170 optimal sensitivity and specificity (about 0.80) and a good correlation with the case of clinical
16 171 depression based on DSM-III and ICD–8/9 diagnostic criteria [34]. HADS is found to perform well in
17 172 assessing the symptom severity and case categorization of anxiety and depressive disorders in the
18 173 general population and in somatic, psychiatric and primary care patients.³⁹ Results are reported as
19 174 prevalence (in %) along with 95 per cent confidence intervals (95% CI) and we also report p-values
20 175 for linear trend according to time. Data management and analyses were done with Stata v. 16.⁴⁰

176 Patient and public involvement

177 Public stakeholders and patient organizations have been involved in the planning of all HUNT
178 Surveys. No patients were involved in the design or implementation of this specific study. As the
179 study used previously collected data, we did not ask patients or the public to assess the burden of
180 participation. Public stakeholders and patient organizations are involved in dissemination of results
181 from the HUNT Study.

183 Ethical approval

184 This study was approved by the Regional Committees for Medical and Health Research Ethics; REK
185 sør-øst C, Norway 196364/2020. All participants gave informed consent before taking part in the
186 HUNT Study.

188 Results

189 The percentage of adolescents screening positive for anxiety and depression nearly doubled
190 between 1995-97 and 2017-19, from 15.3% to 29.8%, with most of the increase occurring between
191 2006-08 and 2017-19 (see Table 1).

193 **Table 1.** Characteristics for the sample aged 13-19 years. The Young-HUNT Study.³⁶

		Young HUNT1 1995-97		Young HUNT3 2006-08		Young HUNT4 2017-19	
		N	%	N	%	N	%
Age	13-19 y	8980	100	8199	100	8066	100
Sex							
	Girls	4463	49.7	4128	50.4	4106	50.9
	Boys	4517	50.3	4071	49.6	3960	49.1
SCL-5*							

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Low	7412	82.5	6441	78.6	5410	67.1
High	1372	15.3	1520	18.5	2404	29.8
Missing	196	2.2	238	2.9	252	3.1
Total	8980	100	8199	100	8066	100

194 *Hopkins Symptom Checklist-5 (SCL-5) cut-off ≥ 2 .

195

196 The percentage of adults screening positive for depression declined from 9.4% in 1995-97 to 6.7% in
 197 2017-19, and the percentage screening positive for anxiety increased from 12.4% in 1995-97 to
 198 13.4% in 2017-19 (see Table 2).

199

200 **Table 2.** Characteristics for the sample aged 20-79 years. The HUNT Study.³⁵

	HUNT2 (1995-97)		HUNT3 (2006-08)		HUNT4 (2017-19)	
	N	(%)	N	(%)	N	(%)
Age groups						
20-29 y	9111	(14.6)	4511	(9.3)	6428	(12.3)
30-39 y	11630	(18.6)	6859	(14.2)	6755	(12.9)
40-49 y	13603	(21.8)	10012	(20.7)	9002	(17.2)
50-59 y	11058	(17.7)	11425	(23.6)	10761	(20.5)
60-69 y	9048	(14.5)	9801	(20.3)	11186	(21.3)
70-79 y	7994	(12.8)	5754	(11.9)	8310	(15.9)
Sex						
Females	32991	(52.8)	26316	(54.4)	28488	(54.3)
Males	29453	(47.2)	22046	(45.6)	23954	(45.7)
HADS Depression*						
Low	51049	(81.8)	34301	(70.9)	35271	(67.3)
High	5855	(9.4)	3453	(7.1)	3505	(6.7)
Missing	5540	(8.9)	10608	(21.9)	13666	(26.1)
HADS Anxiety*						
Low	44462	(71.2)	32192	(66.6)	31594	(60.3)
High	7736	(12.4)	5387	(11.1)	7004	(13.4)
Missing	10246	(16.4)	10783	(22.3)	13844	(26.4)
Total	62444	(100)	48362	(100)	52442	(100)

201 * Hospital Anxiety and Depression Scale (HADS) cut-off ≥ 8 .

202

203 Table 3 shows the trends in prevalence (%) and 95 % confidence interval (95 % CI) for symptoms of
 204 poor mental health by age group and sex. Among adolescents, the prevalence of mental health
 205 symptoms above the recommended cut-off on the SCL-5 scale³⁸ was 10.2% for boys and 21.1% for
 206 girls in the 1990s. In the latest survey (2017-19), the prevalence had changed to 16.5% for boys and
 207 44.4% for girls, with a particularly strong change in the last ten years for girls (figure 2).

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Table 3. Prevalence (%) and 95 per cent confidence interval (95% CI) for symptoms of poor mental health by age group and sex. The HUNT Study, Norway.

Adolescents		Young-HUNT1 1995-97		Young-HUNT3 2006-08		Young-HUNT 4 2017-19		P-value for trend
		Prevalence	95% CI	Prevalence	95% CI	Prevalence	95% CI	
HSCL-5*								
Girls	13-19	21.1	(19.9- 22.3)	27.3	(26.0- 28.7)	44.4	(42.8- 45.9)	0.000
Boys	13-19	10.2	(9.3- 11.1)	10.6	(9.7- 11.6)	16.5	(15.4- 17.7)	0.000
Adults		HUNT2		HUNT3		HUNT4		
HADS depression**								
Females	20-29	4.2	(3.7 - 4.8)	4.6	(3.7 - 5.7)	10.7	(9.5 - 12.0)	0.000
	30-39	6.9	(6.3 - 7.6)	6.3	(5.5 - 7.2)	8.9	(7.9 - 10.1)	0.004
	40-49	9.3	(8.6 - 10.0)	7.7	(6.9 - 8.5)	9.0	(8.2 - 10.0)	0.377
	50-59	12.3	(11.5 - 13.3)	9.0	(8.3 - 9.9)	8.4	(7.7 - 9.3)	0.000
	60-69	14.2	(13.2 - 15.3)	8.8	(8.0 - 9.7)	7.4	(6.7 - 8.2)	0.000
	70-79	17.5	(16.3 - 18.9)	12.6	(11.4 - 14.0)	7.6	(6.8 - 8.5)	0.000
Males	20-29	3.9	(3.3 - 4.5)	5.8	(4.5 - 7.4)	10.2	(8.7 - 11.9)	0.000
	30-39	6.9	(6.2 - 7.6)	7.3	(6.2 - 8.6)	11.6	(10.2 - 13.2)	0.000
	40-49	10.4	(9.7 - 11.2)	9.0	(8.0 - 10.0)	10.2	(9.0 - 11.4)	0.358
	50-59	13.6	(12.7 - 14.6)	10.5	(9.6 - 11.4)	9.4	(8.5 - 10.4)	0.000
	60-69	13.9	(12.8 - 15.0)	11.1	(10.2 - 12.1)	8.4	(7.6 - 9.3)	0.000
	70-79	16.8	(15.4 - 18.2)	13.7	(12.4 - 15.2)	10.5	(9.5 - 11.6)	0.000
HADS anxiety**								
Females	20-29	15.5	(14.4 - 16.5)	19.1	(17.4 - 21.0)	32.0	(30.1 - 33.9)	0.000
	30-39	17.1	(16.1 - 18.1)	17.8	(16.5 - 19.2)	26.7	(25.1 - 28.4)	0.000
	40-49	17.9	(17.0 - 18.9)	17.1	(16.0 - 18.2)	22.1	(20.8 - 23.4)	0.000
	50-59	18.6	(17.5 - 19.8)	18.0	(17.0 - 19.1)	20.4	(19.3 - 21.6)	0.028
	60-69	18.0	(16.7 - 19.3)	16.4	(15.4 - 17.6)	17.9	(16.8 - 19.0)	0.896
	70-79	17.2	(15.7 - 18.8)	17.2	(15.8 - 18.8)	16.2	(15.0 - 17.4)	0.290
Males	20-29	11.9	(10.9 - 13.0)	12.0	(10.2 - 14.2)	19.0	(17.0 - 21.2)	0.000
	30-39	12.9	(12.0 - 13.9)	11.4	(10.0 - 12.9)	18.8	(17.0 - 20.7)	0.000
	40-49	14.0	(13.2 - 15.0)	12.5	(11.4 - 13.7)	16.5	(15.1 - 18.0)	0.030
	50-59	12.5	(11.6 - 13.5)	11.7	(10.8 - 12.7)	15.2	(14.0 - 16.4)	0.001
	60-69	9.2	(8.3 - 10.2)	8.5	(7.6 - 9.4)	11.0	(10.1 - 12.0)	0.004
	70-79	9.4	(8.2 - 10.6)	6.5	(5.6 - 7.6)	8.4	(7.5 - 9.4)	0.325

*Hopkins Symptom Checklist-5 (SCL-5) cut-off ≥ 2 .

** Hospital Anxiety and Depression Scale (HADS) cut-off ≥ 8 .

Figure 2. Prevalence (%) of mental health symptoms measured with SCL-5 (cut-off ≥ 2), from three decades of adolescents in the Young-HUNT Study.

For adults, table 3 shows that an increasing prevalence for depressive symptoms above cut-off with age was observed in both sexes, from around four percent among young adults 20-29 years and around 17% among older people 70-79 years in 1995-97 (figure 3). In contrast to this, the highest

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3 219 prevalence among young women (10.7%), and the lowest among the elderly aged 70-79 (7.6%) were
4 220 observed in the last survey (2017-19) (figure 3).

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8 222 **Figure 3.** Prevalence (%) of depression symptoms measured with HADS-D (cut-off ≥ 8) from three
9 223 decades, the HUNT Study.

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13 225 The prevalence of anxiety symptoms above cut-off measured with by HADS-A was similar in all age
14 226 groups in 1995-97 (table 3); around 10% for men and 17% for women. In the last survey, we
15 227 observed a markedly higher prevalence of anxiety symptoms for both genders for participants aged
16 228 20-39 years (figure 4).

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20 230 **Figure 4.** Prevalence (%) of anxiety symptoms measured with HADS-A (cut-off ≥ 8) from three
21 231 decades, the HUNT Study.

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25 233 The negative trends among young adults and the positive trends among older participants shown in
26 234 figures 3 and 4 were statistically significant in almost all groups (appendix table 1).

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30 236 Discussion

31 237 Results from the large Norwegian population-based HUNT Study of more than 170,000 people
32 238 showed large increases in the prevalence of mental distress among adolescents and young adults
33 239 since the 1990s, especially between 2006-08 and 2017-19. These increases were largest among
34 240 young women, though there were also increases among young men. In contrast, among older adults
35 241 depression rates declined and anxiety symptoms remained largely unchanged.

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39 243 *Possible reasons for change*

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41 244 An important question is whether the increases in mental health issues were influenced by changes
42 245 in socio-cultural and behavioral attitudes towards depression, anxiety, and mental health in general.
43 246 In recent years, mental health has received increased attention in the Norwegian society. As a result,
44 247 it may have become easier for participants to report mental health concerns and express emotion in
45 248 questionnaires. Therefore, a desire by the participant to provide socially desirable responses may
46 249 have affected the results. For the adult participants, we have used a different tool than for
47 250 adolescents, HADS, which showed the exact same trend for participants aged 20-39 years as the SCL-
48 251 5 in adolescents and opposite trends for the elderly. This supports the validity of our findings. In
49 252 addition, results are supported by data from the Norwegian health services and prescription
50 253 databases, clearly demonstrating increasing numbers of individuals either referred for, or in need of,
51 254 treatment for mental health illness among young people.⁴¹ The increase in reported mental health
52 255 issues demonstrated in our data, is also accompanied by an increasing number of adolescents in the
53 256 general population referred to mental health services,⁴² an increased use of psychotropic drugs in
54 257 age groups reporting increasing symptoms,⁴³ and an increasing number of young adults in need of
55 258 social welfare.⁴⁴ In addition, similar increases in mental health issues in countries such as the U.S.

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3 259 have been accompanied by concurrent increases in hospital admissions for self-harm behaviors and
4 260 suicide attempts that cannot be attributed to changes in survey self-reports.^{45 46} It is possible to
5 261 suggest that all these changes are due to trends in increasing socio-cultural openness towards
6 262 mental health issues, however in parallel with the changes we see in our data, behavioral data
7 263 showing similar trends⁴¹ and a clear decline in young people's reporting of happiness and life
8 264 satisfaction over the last ten years,³⁴ this seems unlikely.

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11 265 Thus, taken together, evidence seems to suggest that the observed trends in poorer mental health
12 266 among young people are real. To determine the causes behind such public health trends, is,
13 267 however, challenging. Younger generations clearly face concerns that did not exist to the same
14 268 extent even 10, 20 or 30 years ago. These include climate change, growing social injustice,⁴⁷
15 269 emerging threats to democratic institutions and the consequences of modern technological
16 270 developments.¹⁹ In addition, higher academic pressure reflects the dominant neoliberal political
17 271 preoccupation with competition.³³ When young people's sense of self-worth is dependent on what
18 272 they achieve in school, it can also lead to anxiety and depression.³²

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21 273 Another substantial change in Western societies over this time-period, and which we believe can
22 274 have great significance, has been in technology use. The tech industry's strong influence on young
23 275 people's behavior using deliberately manipulative and exploitive strategies⁴⁸ may be an important
24 276 driver of the observed trends among young people in our data.¹¹ Evidence has shown that heavy
25 277 users of technology, for example, are twice as likely as light users to be depressed or report lower
26 278 levels of well-being.¹¹ These detrimental effects may be associated with an increase in the
27 279 prevalence of loneliness seen after 2012^{28 49} and reduced hours of sleep among adolescents.^{29 30}
28 280 Some have questioned the suggestion that increased time spent on social media is a leading cause of
29 281 increasing mental stress among young people, with individual data revealing only a weak association
30 282 between time use and mental health in a longitudinal study.⁵⁰ However, associations at the
31 283 individual level may be different from the group-level associations we examine here; even non-users
32 284 of technology may be impacted by the changes in social interaction caused by technology use.¹¹ The
33 285 increased acceptance, integration and near-obligatory use of internet-based media technologies to
34 286 access services and social networks in society increasingly either isolate non-users or force them to
35 287 conform. Furthermore, as social norms move away from in-person social interaction, even
36 288 individuals interested in in-person interactions find it increasingly difficult to find others to do so
37 289 with. Social media is social, not just individual, and naturally possesses powerful network effects.²⁷
38 290 Thus, it becomes necessary to look further into the political, historical and cultural context in which
39 291 these behavioral changes unfold.^{17 51}

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42 292 Among older segments of the population, we see no similar increase in mental health issues over the
43 293 study period. In fact, our results highlight rather the opposite – a decrease in mental health related
44 294 issues. Such trends have also been observed in other populations.¹⁴ Older people in Norway benefit
45 295 from good living conditions with financial security in a generous welfare state⁵² and good prospects
46 296 of a high life expectancy.⁵³ Older individuals may also benefit from emotional regulation and
47 297 complex social decision-making, and thus be able to cope with the stress of technological
48 298 developments in other ways than young people.^{14 54}

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52 300 *Strengths*

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55 301 The HUNT Study collects data from a total population at approximately ten years intervals, enabling
56 302 studies of health changes in the population over time.^{35 36} The invitation/sampling of participants,

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3 303 and methods for measuring mental health, have been conducted using the same methods and
4 304 instruments in all three surveys. Large sample sizes have ensured reliable estimates. Health trends in
5 305 the county follow both national⁵⁵ and international western health trends closely.⁵⁶ The population
6 306 is stable and relatively homogenous with a low net migration. As part of a national Nordic welfare
7 307 state, the population recruited is part of a country with a universal public health service and a school
8 308 system where almost everyone attends the same local schools.

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310 *Limitations*

15 311 Our survey data covered approximately 78% of the total adolescent population and 70% to 54% of
16 312 the total adult population (as the result of a decrease in participation from HUNT2 to HUNT3 among
17 313 adults). Non-response analyzes for adult participants have shown that those who choose not to
18 314 participate generally have a higher mortality rate, slightly higher prevalence of chronic illness, and
19 315 lower socioeconomic position than participants.⁵⁷ This may have biased our findings so that
20 316 unfavorable trends among adolescents are underestimated and favorable trends among adults are
21 317 overestimated.

318

319 *Relevance*

27 320 The rapid and almost uncontrolled development in the information technology industry has taken
28 321 place without notable political concern in Norway or other western countries, in line with
29 322 dominating neoliberal political ideology.^{18 58} This development is saturated with paradoxes. We have
30 323 never had greater access to information, but have also never been so poorly informed. It has never
31 324 been easier to contact friends or family, yet more people report being lonely and psychologically
32 325 distressed. The consequences of these technological trends are becoming increasingly apparent. We
33 326 are, of course, not required to abandon technology, however, it is imperative that the consequences
34 327 of these technological developments are to be taken seriously and are reflected in both future
35 328 political and research agendas. Importantly, there is an emerging discussion concerning why it is
36 329 necessary to respond to commercial⁵⁹ and corporate determinants of health, reflecting in part a
37 330 growing appreciation of their enormous power.⁶⁰

41 331 Our results are in line with results suggesting increases in mental health issues observed among
42 332 adolescents and young adults internationally^{8 9} and, more specifically, in the USA.¹¹ Supporting
43 333 research shows, additionally, that social media use has significant effects on mental health,
44 334 particularly in young people.²⁵ The data on both are of great interest to public health policy. The
45 335 undesirable trend has affected many young people and affected everyday life substantially for large
46 336 groups in Norway. Based on earlier findings from the HUNT Study, there is reason to forecast that
47 337 increasing mental health problems may contribute to an increasing incidence of work-related
48 338 incapacity in Norway now and in the years to come.^{6 61}

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340 *Need for further research and need for action*

55 341 Our disturbing findings highlights the need for further research to find out if some of the increase in
56 342 reporting of mental stress simply may be due to greater awareness of mental health or changes in
57 343 reporting. It is, furthermore, necessary to investigate the broad range of potential driving factors
58 344 underlying increased mental health problems in young people. The long term consequences will be
59 345 important to follow, to see if the correlation between mental stress in adolescents and negative

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3 346 outcomes in adulthood will be as expected based on previous studies.⁶¹ Based on what is outlined in
4 347 this paper, there is every reason to consider policy measures to protect youth and young adults
5 348 against increasing mental health distress. A public health policy is needed that strengthens faith in
6 349 the future, demonstrating our influence on living conditions and reduced pressure and stress on
7 350 young people. Experience and evidence from population-based public health and relevant research,
8 351 provides reason to believe that increased regulation of the tech industry, which has enjoyed
9 352 relatively few restrictions for decades, will be important moving forward. Governments and
10 353 individuals could challenge their role in defining the dominant narrative, setting the rules by which
11 354 trade operates, commodifying knowledge and undermining political, social, and economic rights in
12 355 our society.⁶⁰ Relevant measures could be, but are not limited to, for example an enforced age
13 356 minimum for use of social media and online computer gaming, creating increased accountability for
14 357 the content published by technology companies and their platforms, regulations to restrict addictive
15 358 elements of different software, and taxation of the industry to obtain funding for relevant public
16 359 health initiatives. However, of greatest concern is restructuring and regulating the entire economic
17 360 business model on which many of these tech giants not only depend on for their enormously
18 361 powerful profits but have also had a central role in developing for the deliberate manipulation and
19 362 exploitation of its most vulnerable users. Such measures would undoubtedly increase in
20 363 effectiveness through systematic international cooperation. In addition, the academic pressure
21 364 following the dominant political ideology, is another issue that needs to be addressed.⁵¹
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26 366 *Conclusion*

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28 367 The data from the HUNT Study in Norway indicate a strong and worrying increase in mental health
29 368 symptoms among adolescents and young adults, and the opposite trend among the elderly. This
30 369 trend is likely related to significant disruptions in the living conditions of young people in society and
31 370 behavioral changes in adolescents and young adults driven by major socio-political trends, such as
32 371 the growth of neoliberal policy, globalization and an expanding tech industry.²¹ It is urgently
33 372 important that health authorities now see the need to implement political measures to reverse the
34 373 negative trend concerning young people.
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37 374

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40
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44 379 Public Health.
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49 381 **Contributorship statement**

50
51 382 SK was the main author and contributed to the conception and design of the work, acquisition of
52 383 data, interpretation of data, drafting and revising it critically for important intellectual content. DAW
53 384 contributed to interpretation of data, drafting and revising the work critically for important
54 385 intellectual content. MAK contributed to the conception and design, revising the work critically for
55 386 important intellectual content, interpretation of data, and revising it critically for important
56 387 intellectual content. VR contributed to the acquisition of data, analyses and interpretation of data,
57 388 and revising the work critically for important intellectual content. KK contributed to acquisition of
58 389 data, interpretation of data, drafting and revising the work critically for important intellectual
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3 390 content. JMI contributed to acquisition of data, interpretation of data, and revising the work
4 391 critically for important intellectual content. OB contributed to acquisition of data, interpretation of
5 392 data, and revising the work critically for important intellectual content. JMT contributed to
6 393 interpretation of data, drafting and revising the work critically for important intellectual content. ERS
7 394 contributed to the conception and design of the work, acquisition of data, analyses and
8 395 interpretation of data, drafting and revising it critically for important intellectual content. All authors
9 396 approved the final version to be published and are accountable for all aspects of the work. SK accepts
10 397 full responsibility for the work and/or the conduct of the study, had access to the data, and
11 398 controlled the decision to publish. The corresponding author attests that all listed authors meet
12 399 authorship criteria and that no others meeting criteria have been omitted.

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20 404 our license.

21 405 Competing interests

22
23 406 All authors have completed the Unified Competing Interest form (available on request from the
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33 416 take responsibility for the integrity of the data and the accuracy of the data analysis.

34 417 Data sharing statement

35 418 Data sharing: The data used is individual-based sensitive health data that can not be made available
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37 420 available upon reasonable request to the HUNT data access committee (hunt@medisin.ntnu.no).
38 421 The HUNT data access information (www.ntnu.edu/hunt/data) describes in detail the policy about
39 422 data availability.

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42 423 Transparency: The lead author (SK) affirms that the manuscript is an honest, accurate, and
43 424 transparent account of the study being reported; that no important aspects of the study have been
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45 426

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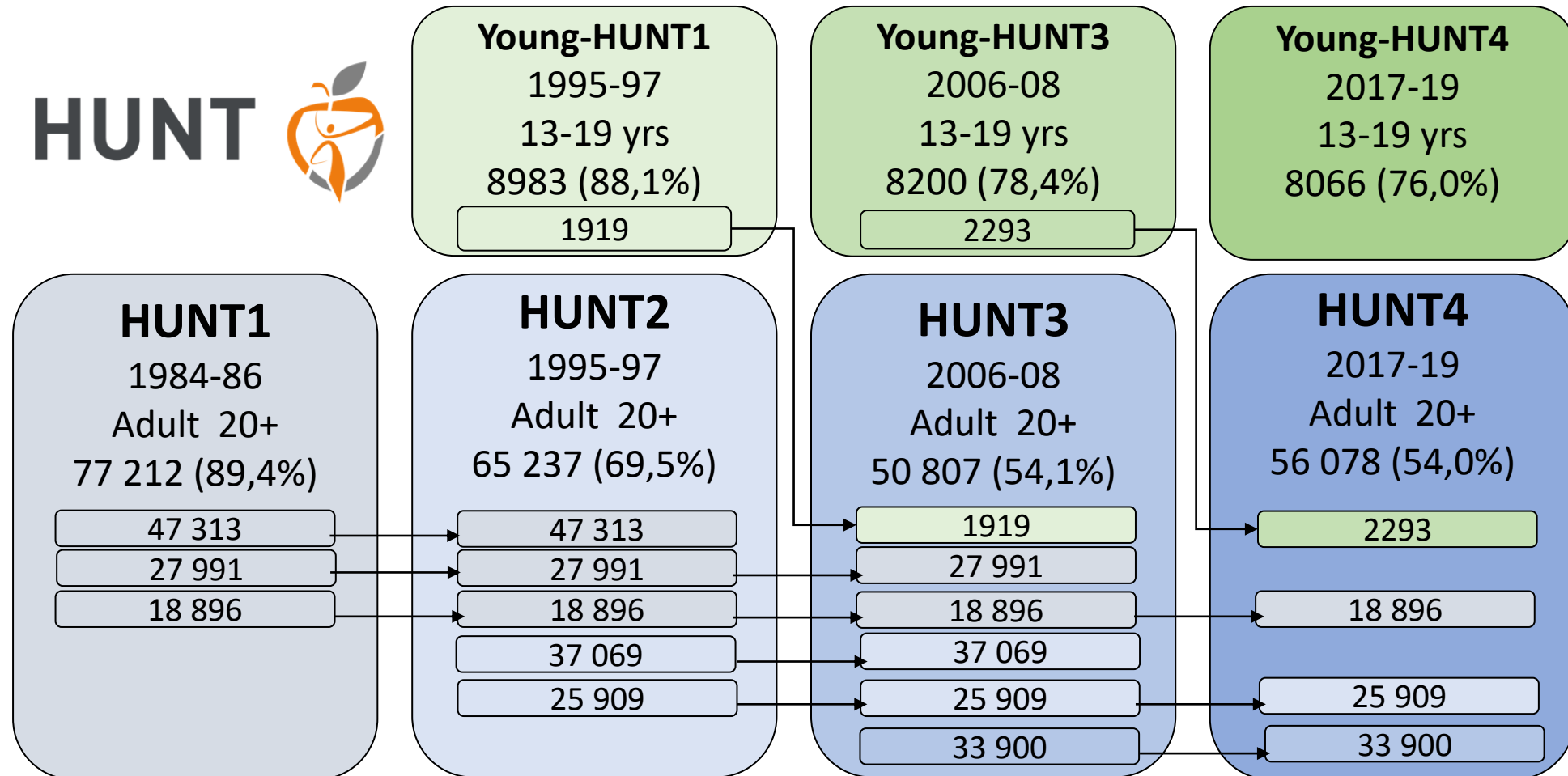
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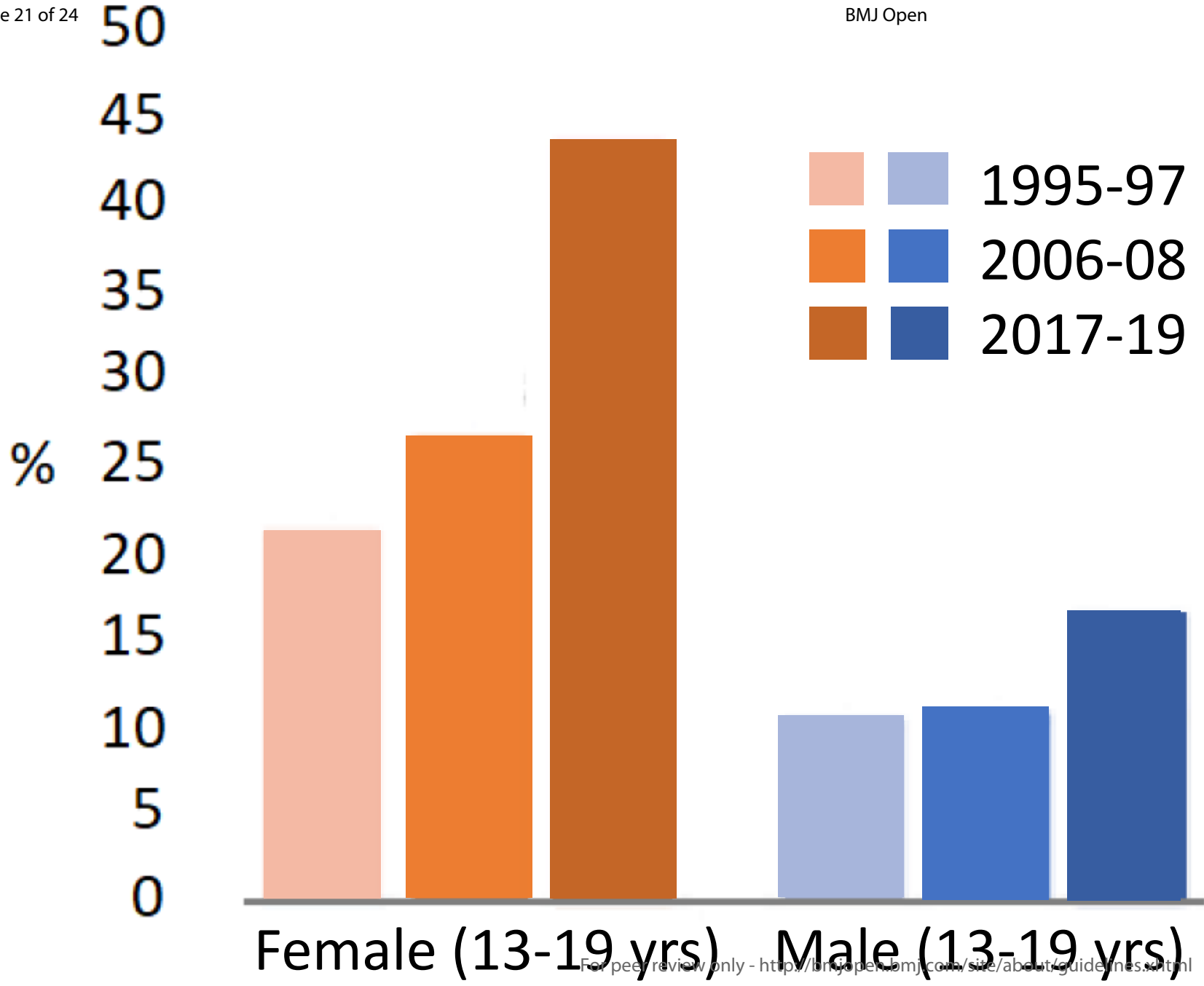
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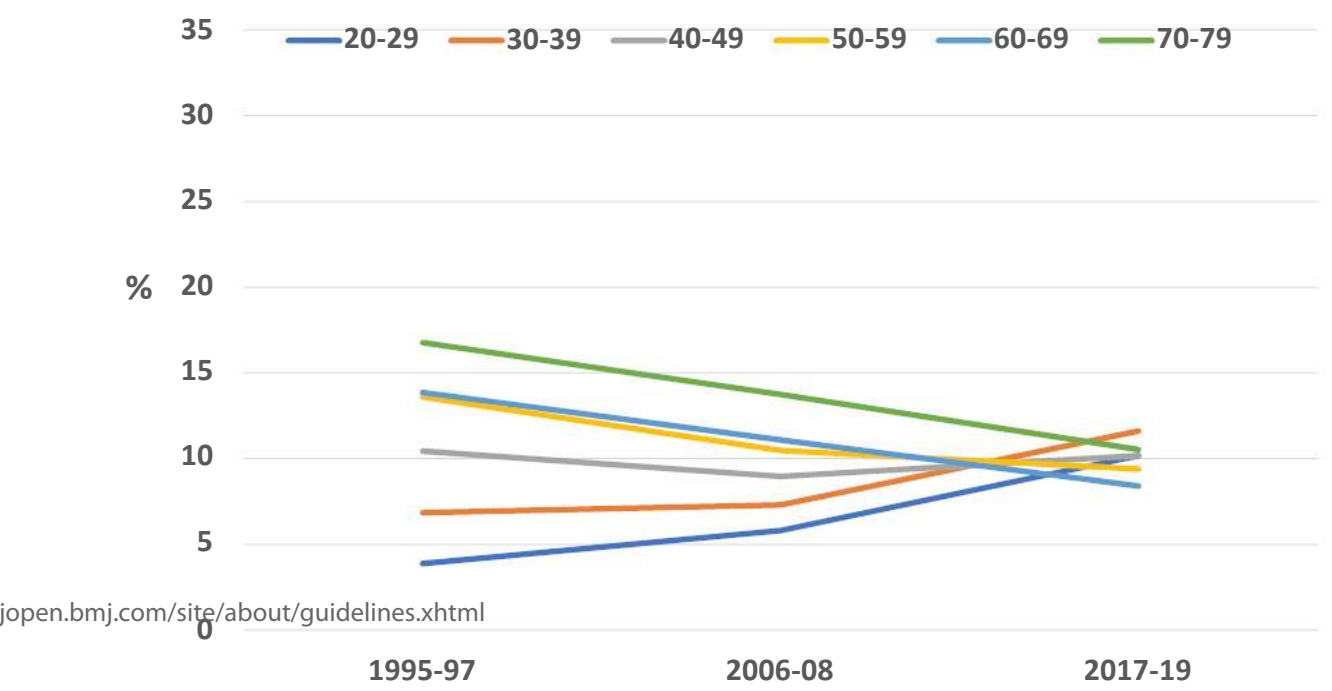
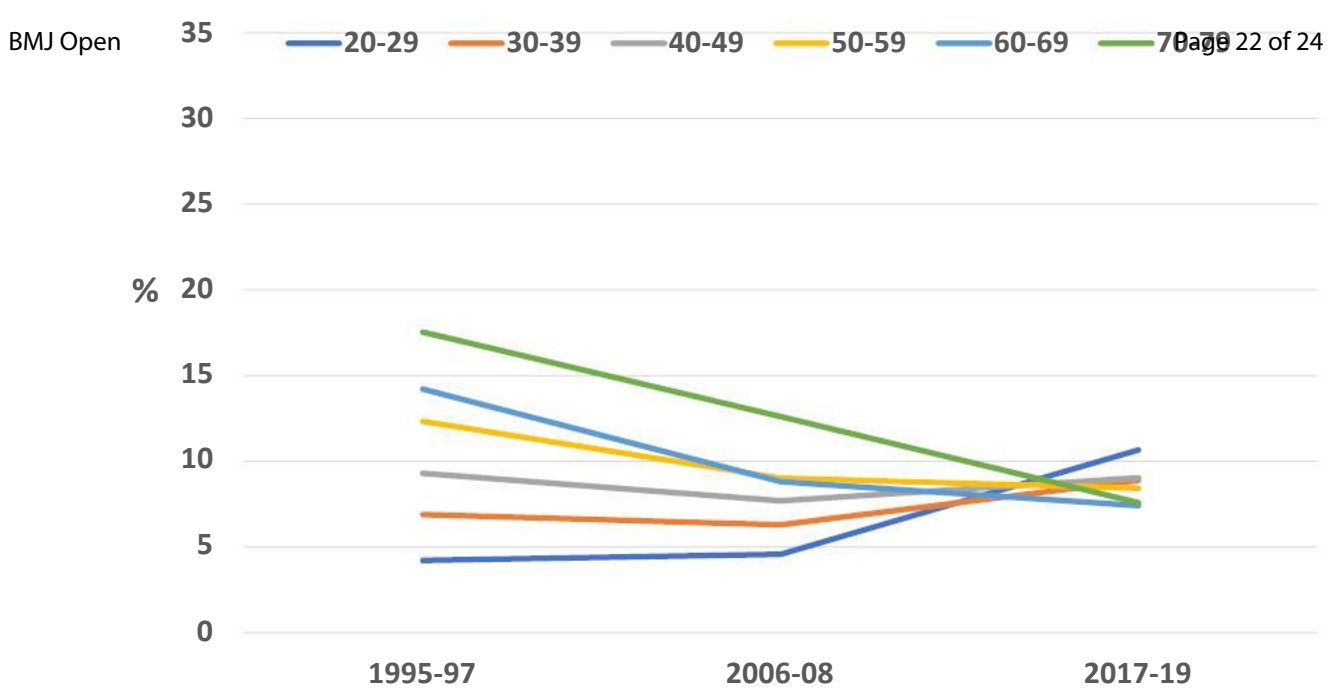
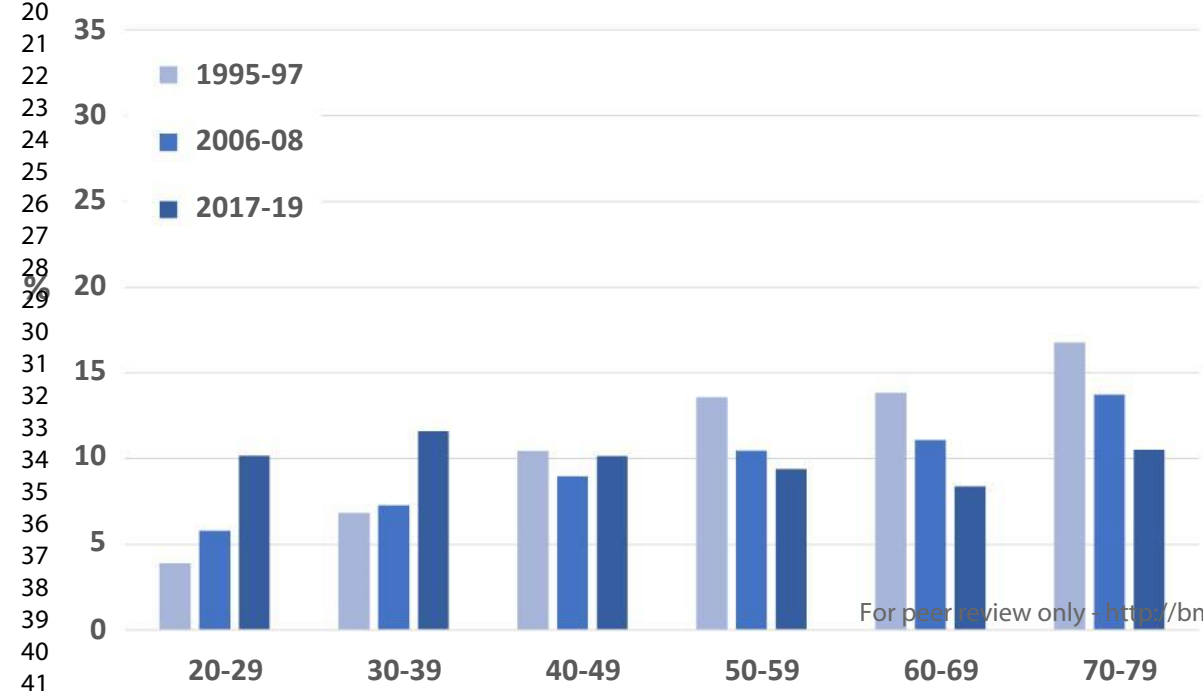
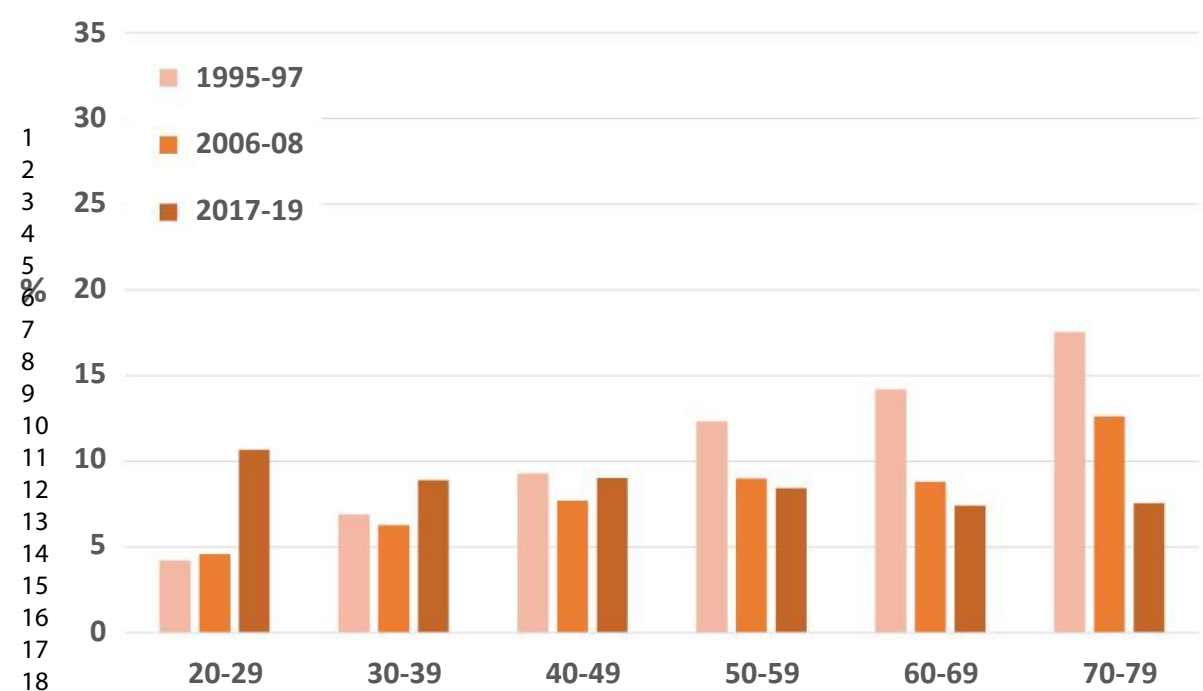


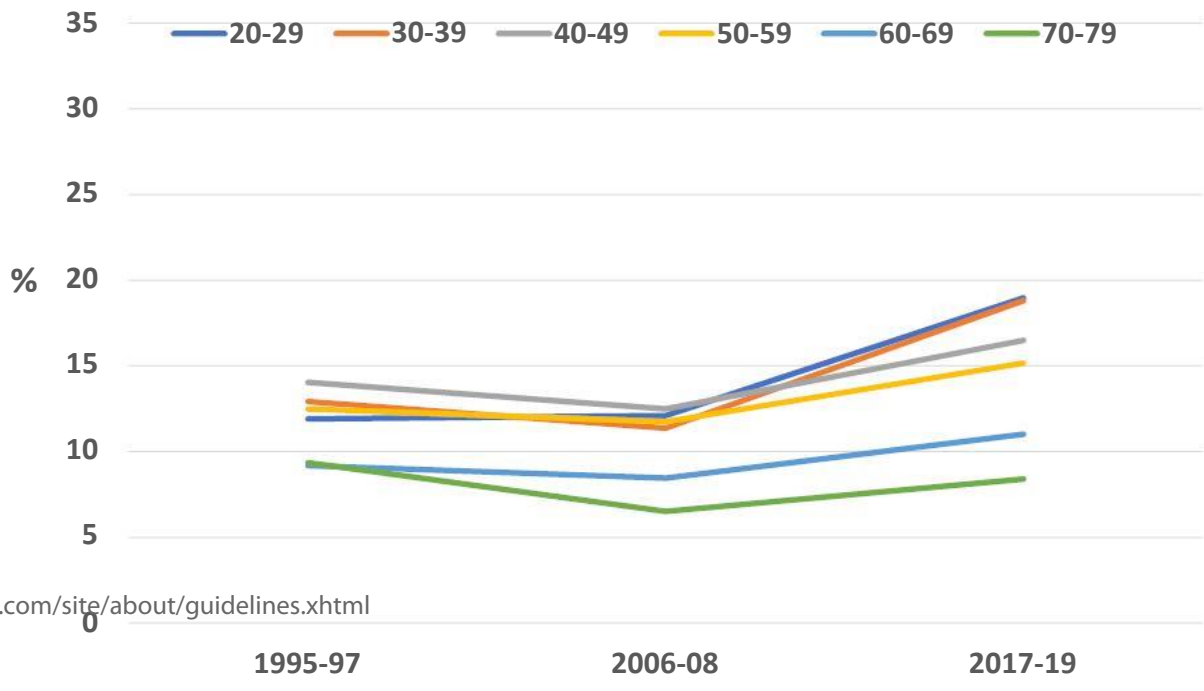
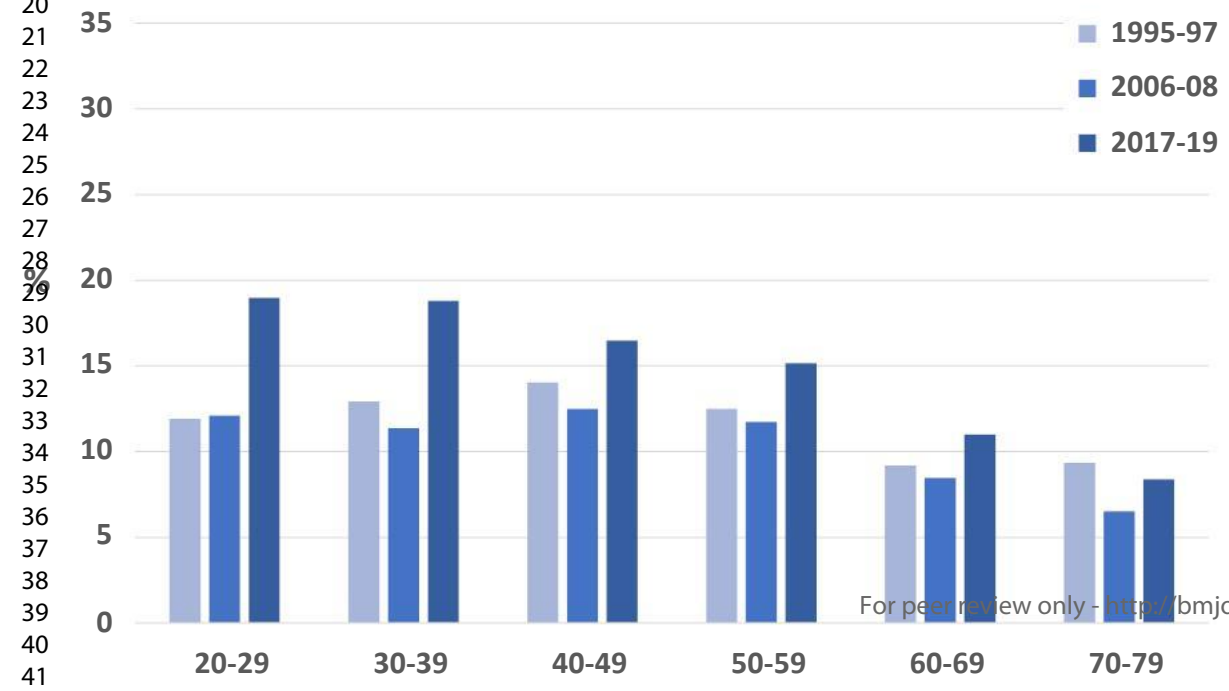
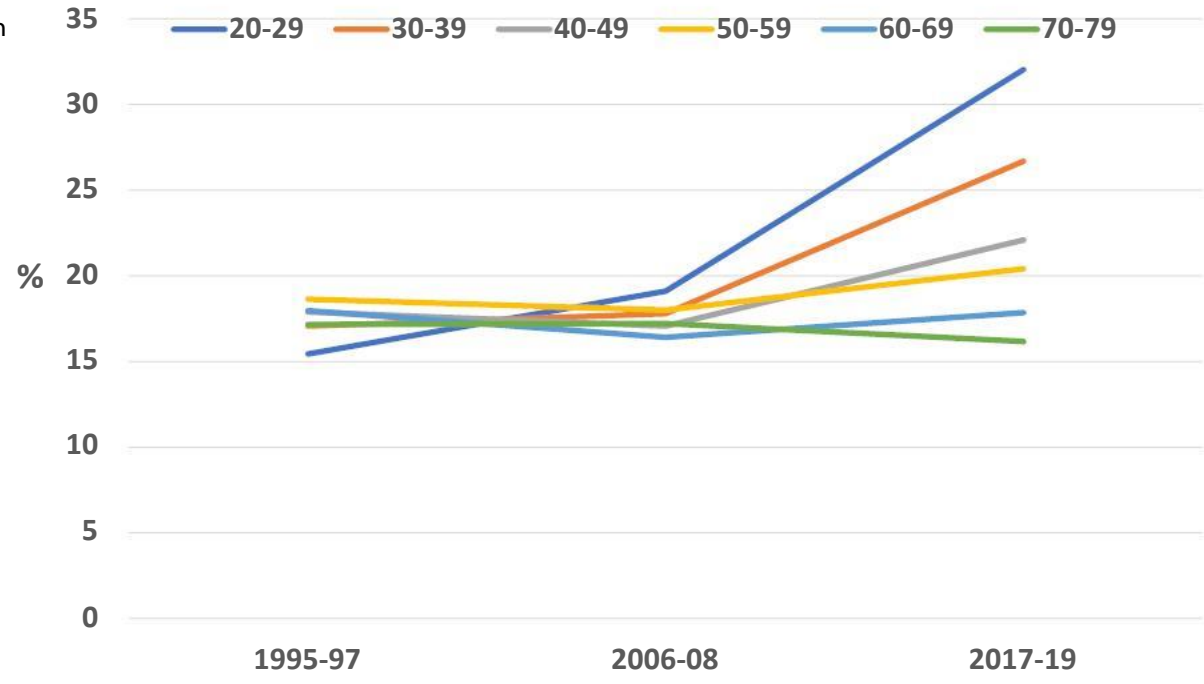
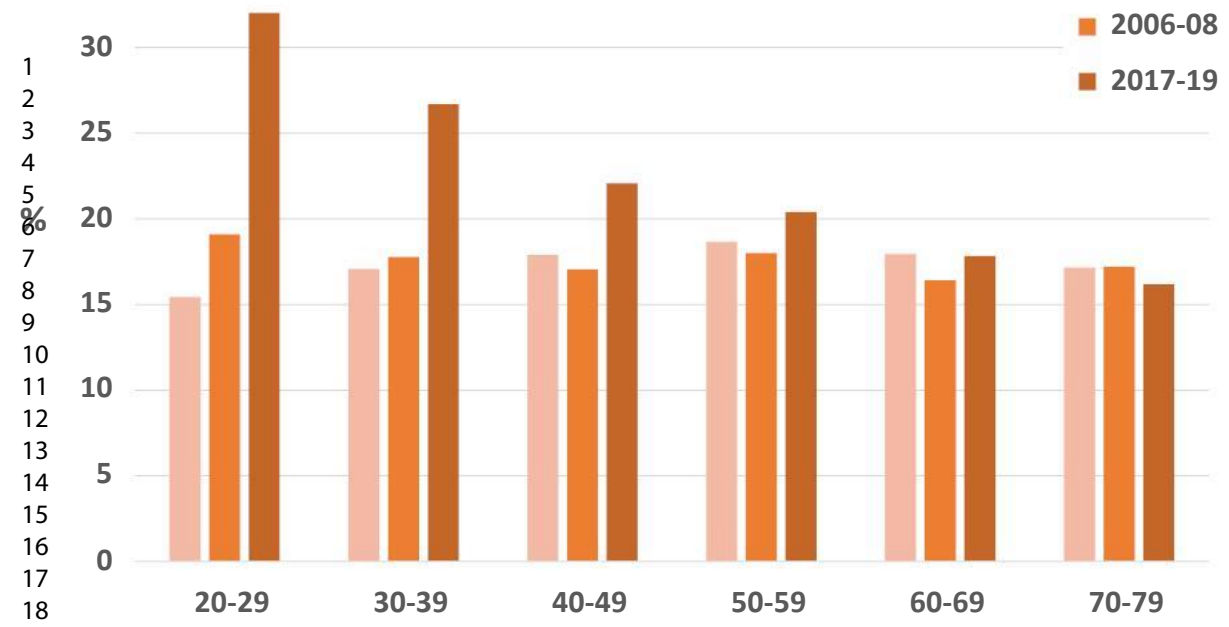
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Female (13-19 yrs) Male (13-19 yrs)





Appendix table 1

Appendix table 1. Prevalence (%) and 95 percent confidence interval (95% CI) for symptoms of poor mental health by age group and sex.

		HUNT2		HUNT3		HUNT4		P-value for trend	
		Prevalence	95% CI	Prevalence	95% CI	Prevalence	95% CI		
HADS depression									
Women	20-29	4.2	(3.7 - 4.8)	4.6	(3.7 - 5.7)	10.7	(9.5 - 12.0)	0.000	
	30-39	6.9	(6.3 - 7.6)	6.3	(5.5 - 7.2)	8.9	(7.9 - 10.1)	0.004	
	40-49	9.3	(8.6 - 10.0)	7.7	(6.9 - 8.5)	9.0	(8.2 - 10.0)	0.377	
	50-59	12.3	(11.5 - 13.3)	9.0	(8.3 - 9.9)	8.4	(7.7 - 9.3)	0.000	
	60-69	14.2	(13.2 - 15.3)	8.8	(8.0 - 9.7)	7.4	(6.7 - 8.2)	0.000	
Men	70-79	17.5	(16.3 - 18.9)	12.6	(11.4 - 14.0)	7.6	(6.8 - 8.5)	0.000	
	20-29	3.9	(3.3 - 4.5)	5.8	(4.5 - 7.4)	10.2	(8.7 - 11.9)	0.000	
	30-39	6.9	(6.2 - 7.6)	7.3	(6.2 - 8.6)	11.6	(10.2 - 13.2)	0.000	
	40-49	10.4	(9.7 - 11.2)	9.0	(8.0 - 10.0)	10.2	(9.0 - 11.4)	0.358	
	50-59	13.6	(12.7 - 14.6)	10.5	(9.6 - 11.4)	9.4	(8.5 - 10.4)	0.000	
HADS anxiety	60-69	13.9	(12.8 - 15.0)	11.1	(10.2 - 12.1)	8.4	(7.6 - 9.3)	0.000	
	70-79	16.8	(15.4 - 18.2)	13.7	(12.4 - 15.2)	10.5	(9.5 - 11.6)	0.000	
	Women	20-29	15.5	(14.4 - 16.5)	19.1	(17.4 - 21.0)	32.0	(30.1 - 33.9)	0.000
		30-39	17.1	(16.1 - 18.1)	17.8	(16.5 - 19.2)	26.7	(25.1 - 28.4)	0.000
		40-49	17.9	(17.0 - 18.9)	17.1	(16.0 - 18.2)	22.1	(20.8 - 23.4)	0.000
50-59		18.6	(17.5 - 19.8)	18.0	(17.0 - 19.1)	20.4	(19.3 - 21.6)	0.028	
60-69		18.0	(16.7 - 19.3)	16.4	(15.4 - 17.6)	17.9	(16.8 - 19.0)	0.896	
Men	70-79	17.2	(15.7 - 18.8)	17.2	(15.8 - 18.8)	16.2	(15.0 - 17.4)	0.290	
	20-29	11.9	(10.9 - 13.0)	12.0	(10.2 - 14.2)	19.0	(17.0 - 21.2)	0.000	
	30-39	12.9	(12.0 - 13.9)	11.4	(10.0 - 12.9)	18.8	(17.0 - 20.7)	0.000	
	40-49	14.0	(13.2 - 15.0)	12.5	(11.4 - 13.7)	16.5	(15.1 - 18.0)	0.030	
	50-59	12.5	(11.6 - 13.5)	11.7	(10.8 - 12.7)	15.2	(14.0 - 16.4)	0.001	
60-69		9.2	(8.3 - 10.2)	8.5	(7.6 - 9.4)	11.0	(10.1 - 12.0)	0.004	
	70-79	9.4	(8.2 - 10.6)	6.5	(5.6 - 7.6)	8.4	(7.5 - 9.4)	0.325	

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

The following recommendations were followed if applicable for the manuscript: Paradoxical trends in mental health in the society and the root causes of increased mental health problems among young people. The HUNT Study, Norway.

	Item No	Recommendation	Page in manus.
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4-5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4-5
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4-5
Bias	9	Describe any efforts to address potential sources of bias	11
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	4
		(b) Describe any methods used to examine subgroups and interactions	4
		(c) Explain how missing data were addressed	5-6
		(d) If applicable, describe analytical methods taking account of sampling strategy	Na
		(e) Describe any sensitivity analyses	Na
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	4
		(b) Give reasons for non-participation at each stage	4
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	5
		(b) Indicate number of participants with missing data for each variable of interest	5

Outcome data	15*	Report numbers of outcome events or summary measures	5
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6-9
		(b) Report category boundaries when continuous variables were categorized	5-9
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Na
Discussion			
Key results	18	Summarise key results with reference to study objectives	9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9-10, 11-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	10
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Divergent decennial trends in mental health according to age reveal poorer mental health for young people. Repeated cross-sectional population-based surveys from the HUNT Study, Norway

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8 Steinar Krokstad (000-0002-2932-6675), Daniel Albert Weiss, Morten Austheim Krokstad, Vegar Rangul, Kirsti Kvaløy, Jo Magne Ingul, Ottar Bjerkeset, Jean Marie Twenge, Erik Reidar Sund.

11 Steinar Krokstad, professor, HUNT Research Centre, Department of Public Health and Nursing, Norwegian University of Science and Technology, 7600 Levanger, Norway.

13 Daniel Albert Weiss, associate professor, Nord University, Faculty of Social Sciences, Universitetsalléen 11, 8026 Bodø, Norway.

15 Morten Austheim Krokstad, PhD Fellow, Faculty of Health Sciences and Nursing, Nord University, 7600 Levanger, Norway.

17 Vegar Rangul, associate professor, HUNT Research Centre, Department of Public Health and Nursing, Norwegian University of Science and Technology, 7600 Levanger, Norway.

19 Kirsti Kvaløy, professor, HUNT Research Centre, Department of Public Health and Nursing, Norwegian University of Science and Technology, 7600 Levanger, Norway.

21 Jo Magne Ingul, psychologist, Levanger Hospital, Nord-Trøndelag Hospital Trust, 7600 Levanger, Norway.

23 Ottar Bjerkeset, professor, Faculty of Health Sciences and Nursing, Nord University, 7600 Levanger, Norway.

25 Jean Marie Twenge, professor, Department of Psychology, College of Sciences, San Diego State University, San Diego, CA 92182-4611, USA.

27 Erik Reidar Sund, senior researcher, HUNT Research Centre, Department of Public Health and Nursing, Norwegian University of Science and Technology, 7600 Levanger, Norway.

30 Correspondence to: Steinar Krokstad (000-0002-2932-6675) steinar.krokstad@ntnu.no

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34 Abstract

35 **Objectives.** Public health trends are formed by political, economic, historical, and cultural factors in
36 society. The aim of this paper was to describe overall changes in mental health among adolescents
37 and adults in a Norwegian population over the three last decades and discuss some potential
38 explanations for these changes.

39 **Design.** Repeated population-based health surveys to monitor decennial changes.

40 **Setting.** Data from three cross-sectional surveys in in 1995-97, 2006-08 and 2017-19 in the
41 population-based HUNT Study in Norway were used.

42 **Participants.** The general population in a Norwegian County covering participants aged 13 to 79
43 years, ranging from 48 000 to 62 000 in each survey.

44 **Main outcome measures.** Prevalence estimates of subjective anxiety and depression symptoms
45 stratified by age and gender were assessed using the Hopkins Symptom Check-List 5 (HSCL-5) for
46 adolescents and the Hospital Anxiety and Depression Scale (HADS) for adults.

47 **Results.** Adolescents' and young adults' mental distress increased sharply, especially between 2006-
48 08 and 2017-19. However, depressive symptoms instead declined among adults ages 60 and over
49 and anxiety symptoms remained largely unchanged in these groups.

50 **Conclusions.** Our trend data from the HUNT Study in Norway indicate poorer mental health among
51 adolescents and young adults that we suggest are related to relevant changes in young people's
52 living conditions and behavior, including the increased influence of screen-based media.

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56 Strengths and limitations of this study

- 57 ➤ The HUNT Study is a large general county population health survey repeated every decade since
- 58 the 1980s in Norway, suitable for following trends in public health
- 59 ➤ The total population 13+ years are invited to complete the survey
- 60 ➤ Identical screening tools for measuring anxiety and depression symptoms have been used in all
- 61 three surveys covered by this article; Hopkins Symptoms Check List 5 for adolescents and
- 62 Hospital Anxiety and Depression Scale for adults
- 63 ➤ Data covered approximately 78% of the total adolescent population and 54% to 70% of the total
- 64 adult population with the risk of selection bias
- 65 ➤ Changes in socio-cultural and behavioral attitudes towards depression, anxiety, and mental
- 66 health in general in recent years may have made it easier for participants to report mental
- 67 health concerns in questionnaires that may have introduced some reporting bias.

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For peer review only

70 Introduction

71 Mental health problems are among the leading causes of disease burden worldwide.^{1,2} Further,
72 mental health issues are primary drivers of disability worldwide, causing over 40 million years of
73 disability in 20 to 29-year-olds.³ Depression alone accounts for more disability-adjusted life years
74 (DALYs) than all other mental disorders together⁴ and is projected to become the leading cause of
75 disability in high-income countries by 2030.⁵ Thus, the public health burden of mood disorders is
76 substantial, with negative effects including functional problems, reduced quality of life, disability,
77 low work productivity, increased mortality, and increased health care utilization.

78 In Norway, estimates of years lived with disability in 2016 display anxiety and depression ranked as
79 number four and seven on the list of the most contributing diseases in the Global Burden of Disease
80 statistics.⁶ Mental disorders are highly prevalent in disability benefit statistics, with awards often
81 granted at younger ages than for other diagnoses. Mental disorders have additionally been shown to
82 be responsible for the most working years lost (33.8%) of any disability.⁷

83 During the last decade, rates of depressive symptoms have increased in several adolescent
84 populations.⁸⁻¹⁰ In the USA, rates of depression, self-harm, and suicide attempts increased
85 substantially in adolescents after 2010.¹¹⁻¹³ On the other hand, data have paradoxically shown an
86 improvement in mental health with age indicating the opposite trend among older people.^{14,15}

87 Several prominent research-based theories and models, which have provided significant support to
88 modern understanding and practice of health promotion and disease prevention, may offer insights
89 into understanding the causes of current trends in mental health. The World Health Organization's
90 Commission on the Social Determinants of Health (SDH), for example, defined the SDH as "the
91 conditions in which people are born, grow, live, work and age" as the fundamental drivers of public
92 health.¹⁶ Thus, when observing emerging trends in population health, it is important to look at the
93 underlying conditions that may drive the changes. The eminent epidemiologist Geoffrey Rose
94 stressed that the determinants of individual cases and the determinants of incidence rates are two
95 different issues. The second seeks the causes of changing incidence of health problems in the
96 population.¹⁷ This theory argues that political, economic, historical, and cultural trends in Western
97 societies may have affected mental health by influencing changes in social living conditions.
98 Neoliberalism has been the dominating political ideology in Europe and US since the 1980s.
99 Economic growth has been the main priority of the neoliberal agenda, together with the
100 deregulation of economies, forcing open national and international markets to trade.¹⁸ This has
101 contributed to major changes in the living conditions of groups in societies around the world,
102 including young people. For many, optimism and the belief in economic growth and improved
103 quality of life have been replaced by concerns about climate change, growing social injustice, threats
104 to democracy and the threat of technological developments leading to increased exploitation and
105 potentially magnifying many of these other concerns.¹⁹ These concerns have become particularly
106 visible for young people growing up in many western, developed societies.

107 It has become increasingly apparent that the rapidly growing global unregulated information
108 technology sector collects and mines enormous amounts of data on individuals.²⁰ The term *dataism*
109 is used to describe the mindset or philosophy created by this trend. Recently, the term has been
110 expanded to describe what others, including leading historian Yuval Noah Harari and leading social
111 psychologist Shoshana Zuboff, has called an emerging form of capitalism, ideology, or even a new
112 form of religion.^{20,21} The increase in global interactions has caused a growth in international trade
113 and the exchange of ideas and culture. Consumerism, the increasing polarization due to so-called
114 technologically produced "echo-chambers" in digitally mediated spaces of social interaction are but

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3 115 a few of the trends influencing these developments.²² Taking selfies, and along with that, improving
4 116 our image for public consumption have become regular in younger generations.²³

6 117 Driven by these societal and technological trends, the use of the internet began to increase in the
7 118 early 2000s, and smartphones after 2010. Social media also became more popular after 2010. These
8 119 trends may have had a significant impact on human behavior, especially among adolescents and
9 120 young adults. In several large studies, heavy users of such technologies are more likely to be
10 121 depressed^{9 24} or have lower levels of well-being.^{9 25} Similarly, the HUNT Study of Norway have shown
11 122 associations between the number of hours of screen time and increased mental health illness, which
12 123 was particularly strong in girls when screen time predominantly involved the use of social media and
13 124 internet.²⁶ Declines in face-to-face social interaction among adolescents may also impact even non-
14 125 users of digital media, increasing the need for social assurance and reducing opportunities for in-
15 126 person social interaction.²⁷ However, the need for social assurance fueled by excessive smartphone
16 127 use is often not gratified, and eventually leads to greater loneliness.²⁸ Some evidence suggests that
17 128 increased time spent using these technologies and, more generally, exposure to the evolving
18 129 modern technological environment may be causes of the sudden increase in depression since
19 130 2010.¹¹ Stronger associations between digital media time and mental health indicators has been
20 131 shown in girls compared to boys, perhaps because social media, used more frequently by girls, is
21 132 more strongly linked to depression than gaming, used more frequently by boys.⁹ Furthermore,
22 133 research on adolescents in Norway has associated psychiatric problems with sleep quality problems,
23 134 which are exacerbated by the use of social media and computer gaming among adolescents.²⁹⁻³¹ In
24 135 addition, higher academic pressure following the dominant political preoccupation with competition
25 136 and a credentials-based labor market influencing educational programs may also have increased
26 137 mental distress among adolescents and students.^{32 33} A Norwegian study has shown a clear decline in
27 138 young peoples' reporting of happiness and life satisfaction over the last ten years. The study
28 139 showed that increasing concern about the future contributed most to the decline. This concern was
29 140 related to fears of various adverse events, such as future job opportunities and one's own financial
30 141 situation. Other conditions such as dissatisfaction with social relationships, health, physical fitness
31 142 and body also had significance.³⁴

32 143 The aim of this paper was to describe the parallel changes in mental health among adolescents and
33 144 adults in a Norwegian population over the three last decades and suggest some potential
34 145 explanations for these changes based on theories related to the social determinants of health.^{16 17}

35 146

36 147 **Methods**

37 148 The data were taken from three different waves in the Trøndelag Health Study (HUNT), Young-
38 149 HUNT1 and HUNT2 (1995-97), Young-HUNT3 and HUNT3 (2006-08) and Young-HUNT4 and HUNT4
39 150 (2017-19)(figure 1).³⁵ The invited participants were the total population in the Nord-Trøndelag
40 151 County area aged 13-19 years (Young-HUNT) and 20+ years (HUNT).³⁶ The numbers and attendance
41 152 rates are shown in figure 1. The samples ranged from 8980 to 8066 adolescent participants and from
42 153 62 444 to 48 362 adult participants.

43 154

44 155 **Figure 1.** Data collected in the HUNT Study, Norway. Number of participants and response rates.^{35 36}

45 156

Data from the different decades were stratified by age and sex. In the Young-HUNT surveys, we applied the Hopkins Symptom Checklist–5 (SCL-5). Hopkins Symptom Checklist–25 (SCL-25) is a widely applied self-report measure of depression and anxiety symptoms. Compared with the SCL-25, the short form model fit is good and correlations with established measures demonstrate convergent validity.^{37 38} Prevalence (%) of depression and anxiety symptoms were measured with SCL-5 (cut-off ≥ 2). For adults, we applied the Hospital Anxiety and Depression Scale (HADS). The HADS is a brief 14-item self-report questionnaire, consisting of seven items for the anxiety subscale (HADS-A) and seven for the depression subscale (HADS-D), each scored on a Likert-scale from 0 (no symptoms) to 3 (symptoms maximally present). For this study, valid ratings of the HADS-D and HADS-A were defined as at least five completed items on both subscales. The score of those who filled in five or six items was based on the sum of completed items multiplied with 7/5 or 7/6, respectively. We used the conventional cut-off threshold of ≥ 8 for the HADS subscales. This cut off value is found to provide optimal sensitivity and specificity (about 0.80) and a good correlation with the case of clinical depression based on DSM-III and ICD–8/9 diagnostic criteria [34]. HADS is found to perform well in assessing the symptom severity and case categorization of anxiety and depressive disorders in the general population and in somatic, psychiatric and primary care patients.³⁹ Results are reported as prevalence (in %) along with 95 per cent confidence intervals (95% CI) and we also report p-values for linear trend according to time. Data management and analyses were done with Stata v. 16.⁴⁰

Patient and public involvement

Public stakeholders and patient organizations have been involved in the planning of all HUNT surveys. No patients were involved in the design or implementation of this specific study. As the study used previously collected data, we did not ask patients or the public to assess the burden of participation. Public stakeholders and patient organizations are involved in dissemination of results from the HUNT Study.

Ethical approval

This study was approved by the Regional Committees for Medical and Health Research Ethics; REC south-east, Norway 196364/2020. All participants gave informed consent before taking part in the HUNT Study.

Results

The percentage of adolescents screening positive for anxiety and depression nearly doubled between 1995-97 and 2017-19, from 15.3% to 29.8%, with most of the increase occurring between 2006-08 and 2017-19 (see Table 1).

Table 1. Characteristics for the sample aged 13-19 years. The Young-HUNT Study.³⁶

		Young HUNT1 1995-97		Young HUNT3 2006-08		Young HUNT4 2017-19	
		N	%	N	%	N	%
Age	13-19 y	8980	100	8199	100	8066	100
Sex							
	Girls	4463	49.7	4128	50.4	4106	50.9
	Boys	4517	50.3	4071	49.6	3960	49.1

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SCL-5*

Low	7412	82.5	6441	78.6	5410	67.1
High	1372	15.3	1520	18.5	2404	29.8
Missing	196	2.2	238	2.9	252	3.1
Total	8980	100	8199	100	8066	100

*Hopkins Symptom Checklist-5 (SCL-5) cut-off ≥ 2 .

The percentage of adults screening positive for depression declined from 9.4% in 1995-97 to 6.7% in 2017-19, and the percentage screening positive for anxiety increased from 12.4% in 1995-97 to 13.4% in 2017-19 (see Table 2).

Table 2. Characteristics for the sample aged 20-79 years. The HUNT Study.³⁵

	HUNT2 (1995-97)		HUNT3 (2006-08)		HUNT4 (2017-19)	
	N	(%)	N	(%)	N	(%)
Age groups						
20-29 y	9111	(14.6)	4511	(9.3)	6428	(12.3)
30-39 y	11630	(18.6)	6859	(14.2)	6755	(12.9)
40-49 y	13603	(21.8)	10012	(20.7)	9002	(17.2)
50-59 y	11058	(17.7)	11425	(23.6)	10761	(20.5)
60-69 y	9048	(14.5)	9801	(20.3)	11186	(21.3)
70-79 y	7994	(12.8)	5754	(11.9)	8310	(15.9)
Sex						
Females	32991	(52.8)	26316	(54.4)	28488	(54.3)
Males	29453	(47.2)	22046	(45.6)	23954	(45.7)
HADS Depression*						
Low	51049	(81.8)	34301	(70.9)	35271	(67.3)
High	5855	(9.4)	3453	(7.1)	3505	(6.7)
Missing	5540	(8.9)	10608	(21.9)	13666	(26.1)
HADS Anxiety*						
Low	44462	(71.2)	32192	(66.6)	31594	(60.3)
High	7736	(12.4)	5387	(11.1)	7004	(13.4)
Missing	10246	(16.4)	10783	(22.3)	13844	(26.4)
Total	62444	(100)	48362	(100)	52442	(100)

* Hospital Anxiety and Depression Scale (HADS) cut-off ≥ 8 .

Table 3 shows the trends in prevalence (%) and 95 % confidence interval (95 % CI) for symptoms of poor mental health by age group and sex. Among adolescents, the prevalence of depression and anxiety symptoms above the recommended cut-off on the SCL-5 scale³⁸ was 10.2% for boys and 21.1% for girls in the 1990s. In the latest survey (2017-19), the prevalence had changed to 16.5% for boys and 44.4% for girls, i.e. particularly large change in the last ten years for girls (figure 2).

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Table 3. Prevalence (%) and 95 per cent confidence interval (95% CI) for symptoms of depression and anxiety by age group and sex. The HUNT Study, Norway.

Adolescents		Young-HUNT1 1995-97		Young-HUNT3 2006-08		Young-HUNT4 2017-19		P-value for trend
		Prevalence	95% CI	Prevalence	95% CI	Prevalence	95% CI	
SCL-5*								
Girls	13-19	21.1	(19.9- 22.3)	27.3	(26.0- 28.7)	44.4	(42.8- 45.9)	0.000
Boys	13-19	10.2	(9.3- 11.1)	10.6	(9.7- 11.6)	16.5	(15.4- 17.7)	0.000
Adults		HUNT2		HUNT3		HUNT4		
HADS depression**								
Females	20-29	4.2	(3.7 - 4.8)	4.6	(3.7 - 5.7)	10.7	(9.5 - 12.0)	0.000
	30-39	6.9	(6.3 - 7.6)	6.3	(5.5 - 7.2)	8.9	(7.9 - 10.1)	0.004
	40-49	9.3	(8.6 - 10.0)	7.7	(6.9 - 8.5)	9.0	(8.2 - 10.0)	0.377
	50-59	12.3	(11.5 - 13.3)	9.0	(8.3 - 9.9)	8.4	(7.7 - 9.3)	0.000
	60-69	14.2	(13.2 - 15.3)	8.8	(8.0 - 9.7)	7.4	(6.7 - 8.2)	0.000
	70-79	17.5	(16.3 - 18.9)	12.6	(11.4 - 14.0)	7.6	(6.8 - 8.5)	0.000
Males	20-29	3.9	(3.3 - 4.5)	5.8	(4.5 - 7.4)	10.2	(8.7 - 11.9)	0.000
	30-39	6.9	(6.2 - 7.6)	7.3	(6.2 - 8.6)	11.6	(10.2 - 13.2)	0.000
	40-49	10.4	(9.7 - 11.2)	9.0	(8.0 - 10.0)	10.2	(9.0 - 11.4)	0.358
	50-59	13.6	(12.7 - 14.6)	10.5	(9.6 - 11.4)	9.4	(8.5 - 10.4)	0.000
	60-69	13.9	(12.8 - 15.0)	11.1	(10.2 - 12.1)	8.4	(7.6 - 9.3)	0.000
	70-79	16.8	(15.4 - 18.2)	13.7	(12.4 - 15.2)	10.5	(9.5 - 11.6)	0.000
HADS anxiety**								
Females	20-29	15.5	(14.4 - 16.5)	19.1	(17.4 - 21.0)	32.0	(30.1 - 33.9)	0.000
	30-39	17.1	(16.1 - 18.1)	17.8	(16.5 - 19.2)	26.7	(25.1 - 28.4)	0.000
	40-49	17.9	(17.0 - 18.9)	17.1	(16.0 - 18.2)	22.1	(20.8 - 23.4)	0.000
	50-59	18.6	(17.5 - 19.8)	18.0	(17.0 - 19.1)	20.4	(19.3 - 21.6)	0.028
	60-69	18.0	(16.7 - 19.3)	16.4	(15.4 - 17.6)	17.9	(16.8 - 19.0)	0.896
	70-79	17.2	(15.7 - 18.8)	17.2	(15.8 - 18.8)	16.2	(15.0 - 17.4)	0.290
Males	20-29	11.9	(10.9 - 13.0)	12.0	(10.2 - 14.2)	19.0	(17.0 - 21.2)	0.000
	30-39	12.9	(12.0 - 13.9)	11.4	(10.0 - 12.9)	18.8	(17.0 - 20.7)	0.000
	40-49	14.0	(13.2 - 15.0)	12.5	(11.4 - 13.7)	16.5	(15.1 - 18.0)	0.030
	50-59	12.5	(11.6 - 13.5)	11.7	(10.8 - 12.7)	15.2	(14.0 - 16.4)	0.001
	60-69	9.2	(8.3 - 10.2)	8.5	(7.6 - 9.4)	11.0	(10.1 - 12.0)	0.004
	70-79	9.4	(8.2 - 10.6)	6.5	(5.6 - 7.6)	8.4	(7.5 - 9.4)	0.325

*Hopkins Symptom Checklist-5 (SCL-5) cut-off ≥ 2 .

** Hospital Anxiety and Depression Scale (HADS) cut-off ≥ 8 .

Figure 2. Prevalence (%) of depression and anxiety symptoms measured with SCL-5 (cut-off ≥ 2), from three decades of adolescents in the Young-HUNT Study.

For adults, table 3 shows that an increasing prevalence for depressive symptoms above cut-off with age was observed in both sexes, from around four percent among young adults 20-29 years and around 17% among older people 70-79 years in 1995-97 (figure 3). In contrast to this, the highest

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219 prevalence among young women (10.7%), and the lowest among the elderly aged 70-79 (7.6%) were
220 observed in the last survey (2017-19) (figure 3).

221

222 **Figure 3.** Prevalence (%) of depression symptoms measured with HADS-D (cut-off ≥ 8) from three
223 decades, the HUNT Study.

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225 The prevalence of anxiety symptoms above cut-off measured with HADS-A was similar in all age
226 groups in 1995-97 (table 3); around 10% for men and 17% for women. In the last survey, we
227 observed a markedly higher prevalence of anxiety symptoms for both genders for participants aged
228 20-39 years (figure 4).

229

230 **Figure 4.** Prevalence (%) of anxiety symptoms measured with HADS-A (cut-off ≥ 8) from three
231 decades, the HUNT Study.

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233 The negative trends among young adults and the positive trends among older participants shown in
234 figures 3 and 4 were statistically significant in almost all groups (appendix table 1).

235

236 Discussion

237 Results from the large Norwegian population-based HUNT Study of more than 170,000 people
238 showed large increases in the prevalence of depression and anxiety symptoms among adolescents
239 and young adults since the 1990s, especially between 2006-08 and 2017-19. These increases were
240 largest among young women, though there were also increases among young men. In contrast,
241 among older adults rates of depressive symptoms declined and anxiety symptoms remained largely
242 unchanged.

243

244 *Possible reasons for change*

245 An important question is whether the increases in mental health illness were influenced by changes
246 in socio-cultural and behavioral attitudes towards depression, anxiety, and mental health in general.
247 In recent years, mental health among young people has received increased attention in the
248 Norwegian society. As a result, it may have become easier for young participants to report mental
249 health concerns and express emotion in questionnaires. For the adult participants, we have used a
250 different tool than for adolescents (HADS), however, the exact same trend for participants aged 20-
251 39 years as in adolescents was identified. The opposite trend was observed for the elderly. The fact
252 that two different instruments present similar trends among young people in our sample supports
253 the validity of our findings. In addition, results are supported by data from the Norwegian health
254 services and prescription databases, clearly demonstrating increasing numbers of individuals either
255 referred for, or in need of treatment for mental health illness among young people.⁴¹ The increase
256 in reported depression and anxiety symptoms demonstrated in our data, is also accompanied by an
257 increasing number of adolescents in the general population referred to mental health services,⁴² an
258 increased use of psychotropic drugs in age groups reporting increasing symptoms,⁴³ and an

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3 259 increasing number of young adults in need of social welfare.⁴⁴ In addition, similar increases in mental
4 260 health issues in countries such as the U.S. have been accompanied by concurrent increases in
5 261 hospital admissions for self-harm behaviors and suicide attempts that cannot be attributed to
6 262 changes in survey self-reports.^{45 46} Consistent with the changes we see in our Norwegian data, a
7 263 clear decline in young people's happiness and life satisfaction over the last ten years has been
8 264 reported as well.³⁴

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11 265 Thus, taken together, evidence seems to suggest that the observed trends in poorer mental health
12 266 among young people are real. To determine the causes behind such public health trends, is,
13 267 however, challenging. Younger generations clearly face concerns that have increased in significance
14 268 and importance throughout the previous few decades. These include worsening climate change,
15 269 growing social injustice,⁴⁷ emerging threats to democratic institutions and the propagation of
16 270 consequences related to the advent of innovative modern technological developments.¹⁹ In
17 271 addition, higher academic pressure reflects the dominant neoliberal political preoccupation with
18 272 competition.³³ When young people's sense of self-worth is dependent on what they achieve in
19 273 school, it can also lead to anxiety and depression if they do not achieve expected results.³²

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23 274 Another substantial change in Western societies during the last decade, and which we believe may
24 275 have great significance, has been in technology use. The tech industry's strong influence on young
25 276 people's behavior using deliberately manipulative and exploitive strategies may be an important
26 277 driver of the observed trends among young people in our data.¹¹ Growing use of social media as a
27 278 daily activity has led to the emergence of ethical concerns related to the management of data.⁴⁸
28 279 Several studies have demonstrated the mechanisms of addiction to electronic devices used to access
29 280 these digital ecosystems.^{20 49} Addiction to social networks is a consequence of users' fear of missing
30 281 out, feeling that they have an impact on others, and make them feel an instant reward when they
31 282 publish content about themselves.⁴⁸ Evidence has shown that heavy users of social media, for
32 283 example, are twice as likely as light users to be depressed or report lower levels of well-being.¹¹
33 284 These effects may be associated with an increase in the prevalence of loneliness seen after 2012^{28 50}
34 285 and reduced hours of sleep among adolescents.^{29 30} Some have questioned the suggestion that
35 286 increased time spent on social media is a leading cause of adverse mental health among young
36 287 people, with individual data revealing only a weak association between time use and mental health
37 288 in a longitudinal study.⁵¹ However, associations at the individual level may be different from the
38 289 group-level associations we examine here; even non-users of technology may be impacted by the
39 290 changes in social interaction caused by technology use.¹¹ The increased acceptance, integration and
40 291 near-obligatory use of internet-based media technologies to access services and social networks in
41 292 society increasingly either isolate non-users or force them to conform. Furthermore, as social norms
42 293 move away from in-person social interaction, even individuals interested in in-person interactions
43 294 find it increasingly difficult to find others to do so with. Social media is social, not just individual, and
44 295 naturally possesses powerful network effects.²⁷ Thus, it becomes necessary to look further into the
45 296 political, historical and cultural context in which these behavioral changes unfold.^{17 52}

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51 297 Among older segments of the population, we see no similar increase in mental health issues over the
52 298 study period. In fact, our results highlight rather the opposite – improved mental health. Such trends
53 299 have also been observed in other populations.¹⁴ National survey data in Norway shows that social
54 300 media use follows a consistent age gradient, with younger populations showing considerably more
55 301 use of social media daily compared to older.⁵³ Older people in Norway benefit from good living
56 302 conditions with financial security in a generous welfare state⁵⁴ and good prospects of high life
57 303 expectancy.⁵⁵ Older individuals may also benefit from emotional regulation and complex social

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3 304 decision-making, and thus be able to cope with the stress of technological developments in other
4 305 ways than young people.^{14 56}

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8 307 *Strengths*

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10 308 The HUNT Study collects data from a total population at approximately ten years intervals, enabling
11 309 studies of health changes in the population over time.^{35 36} The invitation/sampling of participants,
12 310 and methods for measuring mental health, have been conducted using the same methods and
13 311 instruments in all three surveys included in the present study. Large sample sizes have ensured
14 312 reliable estimates. Health trends in the county follow both national⁵⁷ and international western
15 313 health trends closely.⁵⁸ The population is stable and relatively homogenous with a low net migration.
16 314 As part of a national Nordic welfare state, the population recruited is part of a country with a
17 315 universal public health service and a school system where almost everyone attends the same local
18 316 schools.

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23 318 *Limitations*

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25 319 Our survey data covered approximately 78% of the total adolescent population and 70% to 54% of
26 320 the total adult population (as the result of a decrease in participation from HUNT2 to HUNT3 among
27 321 adults). Non-response analyzes for adult participants have shown that those who choose not to
28 322 participate generally have a higher mortality rate, slightly higher prevalence of chronic illness, and
29 323 lower socioeconomic position than participants.⁵⁹ This may have biased our findings so that
30 324 unfavorable trends among adolescents are underestimated and favorable trends among adults are
31 325 overestimated. The study design does not allow for causal inferences.

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36 327 *Relevance*

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38 328 The tech industry's strong influence on young people's behavior has taken place without notable
39 329 political concern in Norway or other western countries, in line with dominating neoliberal political
40 330 ideology.^{18 60} This has allowed the rapid expansion of innovative technologies by commercial and
41 331 corporate actors to facilitate the exploitation of spheres of society relatively untouched by capitalist
42 332 interests before the emergence of these technologies. The consequences are however not going
43 333 completely unrecognized and awareness is growing, in part represented by an emerging discussion
44 334 and appreciation for addressing the power and influence of commercial⁶¹ and corporate
45 335 determinants of health.⁶²

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48 336 Our results are in line with results suggesting poorer mental health observed among adolescents and
49 337 young adults internationally^{8 9} and, more specifically, in the USA.¹¹ Supporting research shows,
50 338 additionally, that social media use has significant effects on mental health, particularly in young
51 339 people.²⁵ The data on both are of great interest to public health policy. The undesirable trend has
52 340 affected many young people and affected everyday life substantially for large groups in Norway.
53 341 Based on earlier findings from the HUNT Study, there is reason to forecast that poorer mental health
54 342 may contribute to an increasing incidence of work-related incapacity in Norway now and in the years
55 343 to come.^{6 63}

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345 *Need for further research and need for action*

346 Our findings highlight the need for further research to find out if some of the reductions in mental
347 health simply may be due to greater awareness of mental health or changes in reporting. It is,
348 furthermore, necessary to investigate the broad range of potential driving factors underlying
349 increased mental health problems in young people. The long term consequences will be important
350 to follow, to see if the correlation between poorer mental health in adolescents and negative
351 outcomes in adulthood will be as expected based on previous studies.⁶³ Based on what is outlined in
352 this paper, there is every reason to consider policy measures to protect youth and young adults
353 against increasing mental health distress. A public health policy is needed that strengthens faith in
354 the future, demonstrating our influence on living conditions and reduced pressure and stress on
355 young people. Experience and evidence from population-based public health and relevant research,
356 provides reason to believe that increased regulation of the tech industry, which has enjoyed
357 relatively few restrictions for decades, will be important moving forward. Governments and
358 individuals could challenge their role in defining the dominant narrative, setting the rules by which
359 trade operates, commodifying knowledge and undermining political, social, and economic rights in
360 our society.⁶² Relevant measures could be, but are not limited to, an enforced age minimum for use
361 of social media and online computer gaming, creating increased accountability for the content
362 published by technology companies and their platforms, regulations to restrict addictive elements of
363 different software, and taxation of the industry to obtain funding for relevant public health
364 initiatives. However, of greatest concern is restructuring and regulating the entire economic
365 business model on which many of these tech giants not only depend on for their enormously
366 powerful profits but have also had a central role in developing for the deliberate manipulation and
367 exploitation of its most vulnerable users. Such measures would undoubtedly increase in
368 effectiveness through systematic international cooperation. In addition, the effects of climate
369 change and global economic policy and academic pressure as a result of dominant political ideology,
370 also should be further investigated.⁵²

372 *Conclusion*

373 The data from the HUNT Study in Norway indicate a strong increase in depression and anxiety
374 symptoms among adolescents and young adults, and the opposite trend among the elderly. This
375 trend is likely related to significant disruptions in the living conditions of young people in society and
376 behavioral changes in adolescents and young adults, which we suggest are likely driven by major
377 socio-political trends, such as the growth of neoliberal policy, globalization and an expanding tech
378 industry.²¹ The results of this study show that is urgently important that health authorities now see
379 the need to implement significant political measures to address the underlying trends in mental
380 health, and their causes, seen in young people.

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386 Public Health.

387

388 Contributor statement

389 SK was the main author and contributed to the conception and design of the work, acquisition of
390 data, interpretation of data, drafting and revising it critically for important intellectual content. DAW
391 contributed to interpretation of data, drafting and revising the work critically for important
392 intellectual content. MAK contributed to the conception and design, revising the work critically for
393 important intellectual content, interpretation of data, and revising it critically for important
394 intellectual content. VR contributed to the acquisition of data, analyses and interpretation of data,
395 and revising the work critically for important intellectual content. KK contributed to acquisition of
396 data, interpretation of data, drafting and revising the work critically for important intellectual
397 content. JMI contributed to acquisition of data, interpretation of data, and revising the work
398 critically for important intellectual content. OB contributed to acquisition of data, interpretation of
399 data, and revising the work critically for important intellectual content. JMT contributed to
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412 Competing interests

413 All authors have completed the Unified Competing Interest form (available on request from the
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423 take responsibility for the integrity of the data and the accuracy of the data analysis.

424 Data sharing statement

425 Data sharing: The data used is individual-based sensitive health data that can not be made available
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427 available upon reasonable request to the HUNT data access committee (hunt@medisin.ntnu.no).

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3 428 The HUNT data access information (www.ntnu.edu/hunt/data) describes in detail the policy about
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6 430 Transparency: The lead author (SK) affirms that the manuscript is an honest, accurate, and
7 431 transparent account of the study being reported; that no important aspects of the study have been
8 432 omitted; and any discrepancies from the study as planned have been explained.

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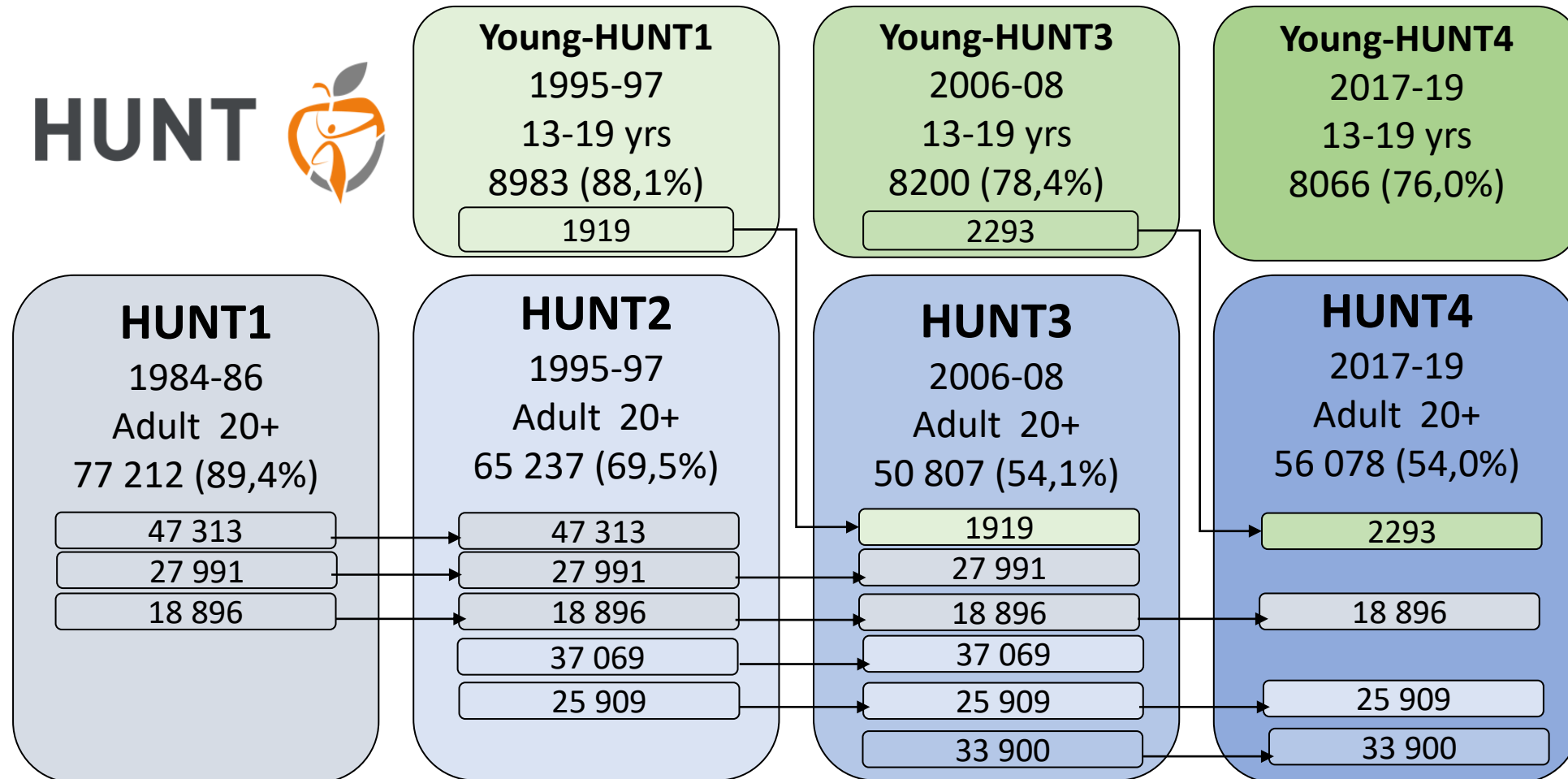
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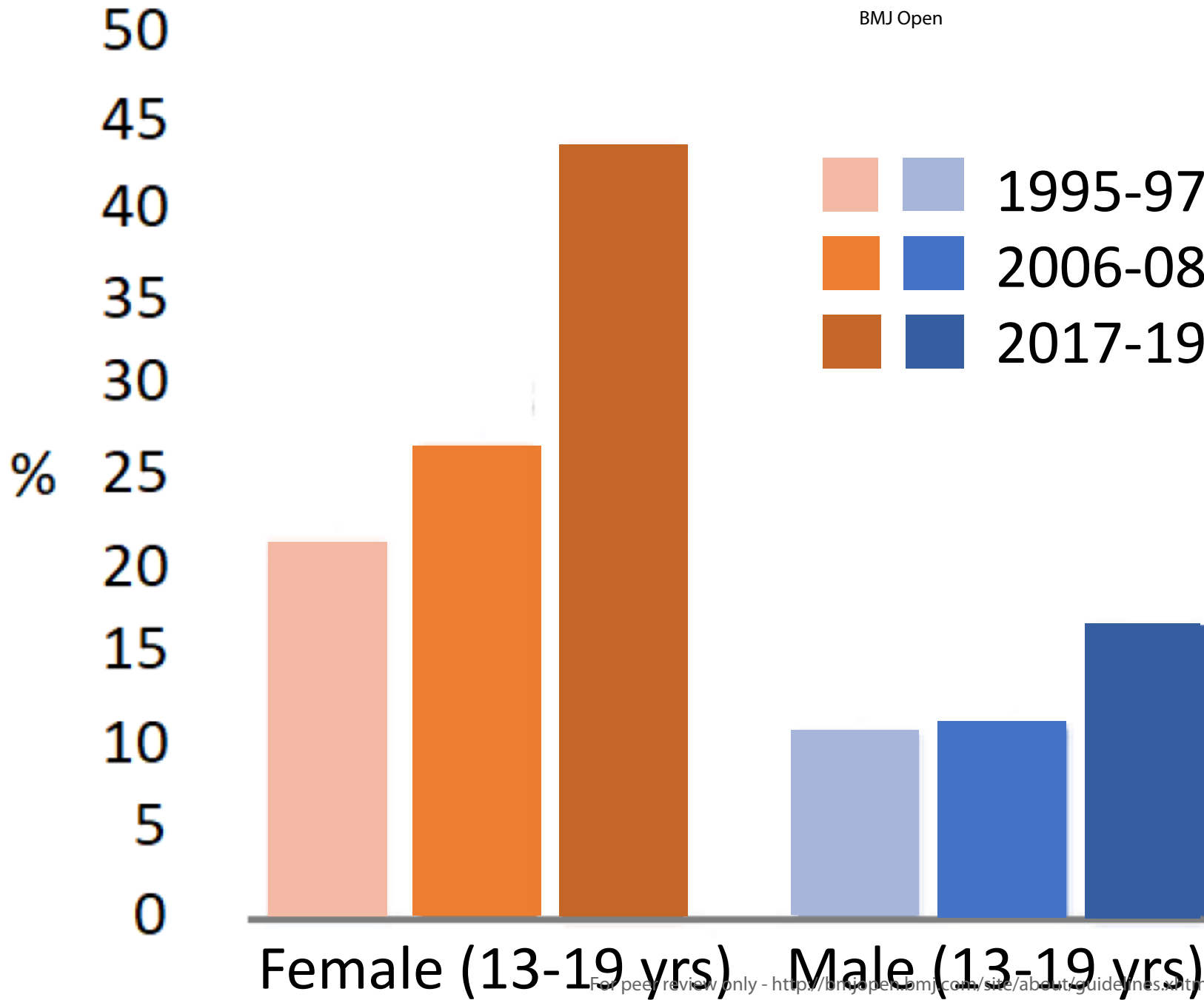
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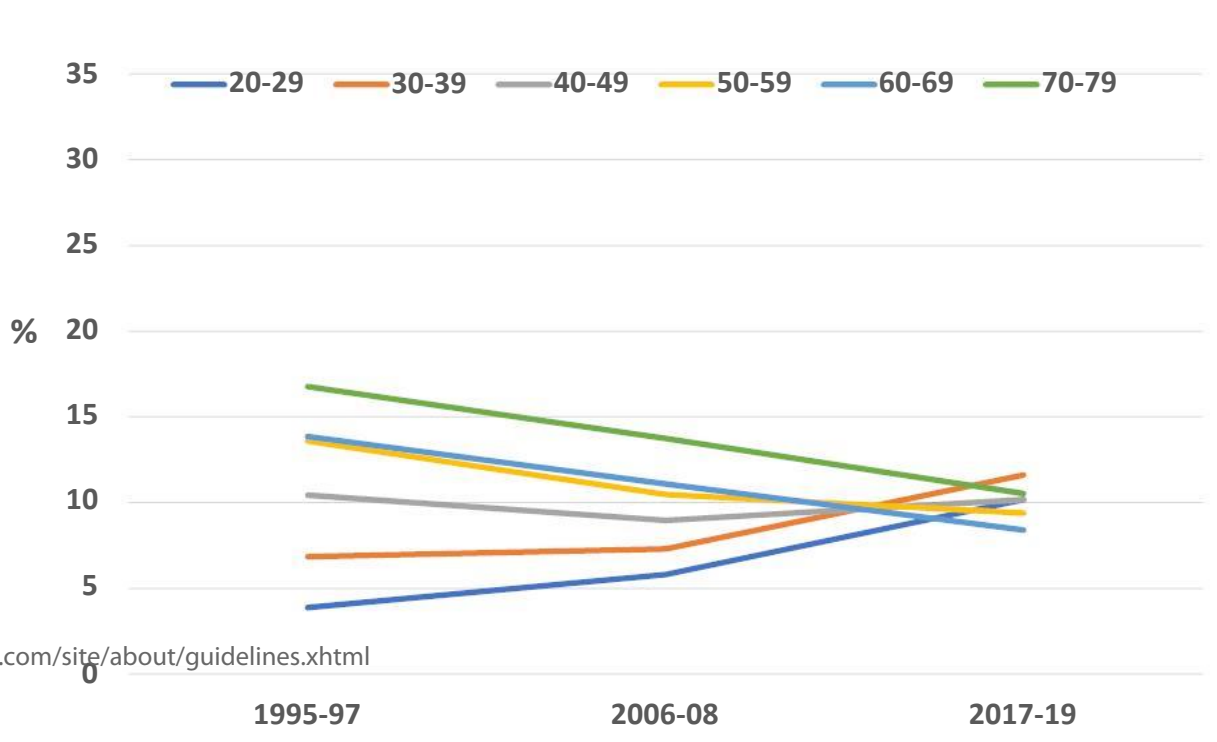
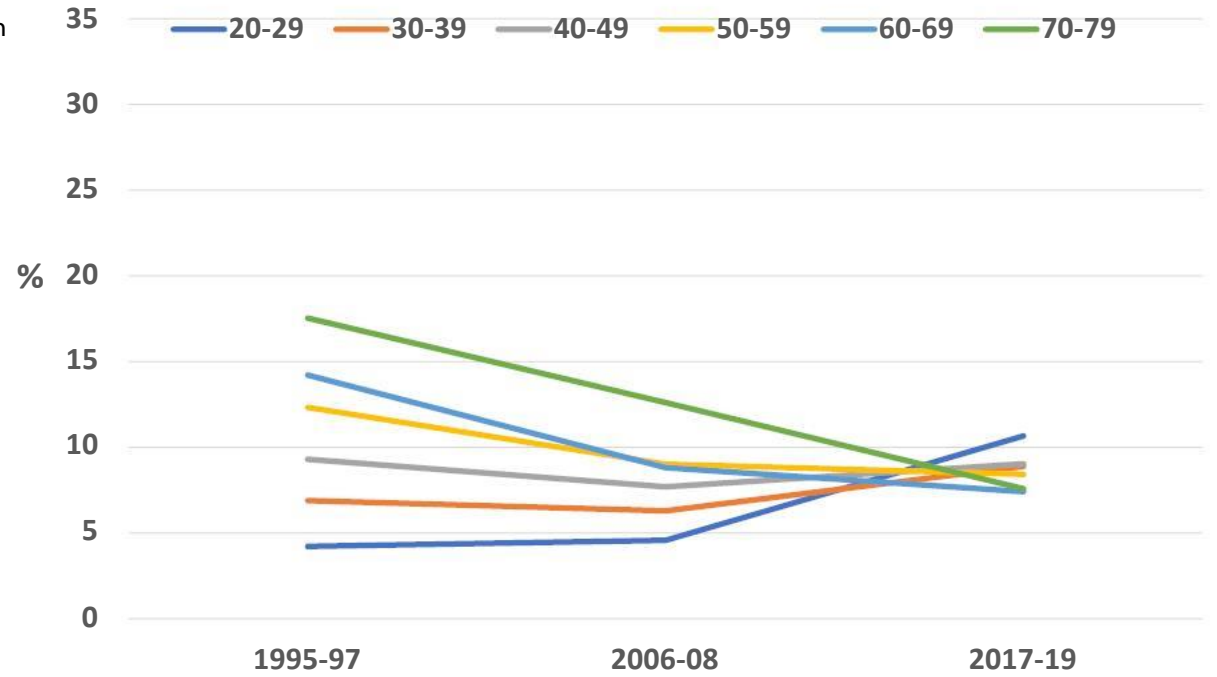
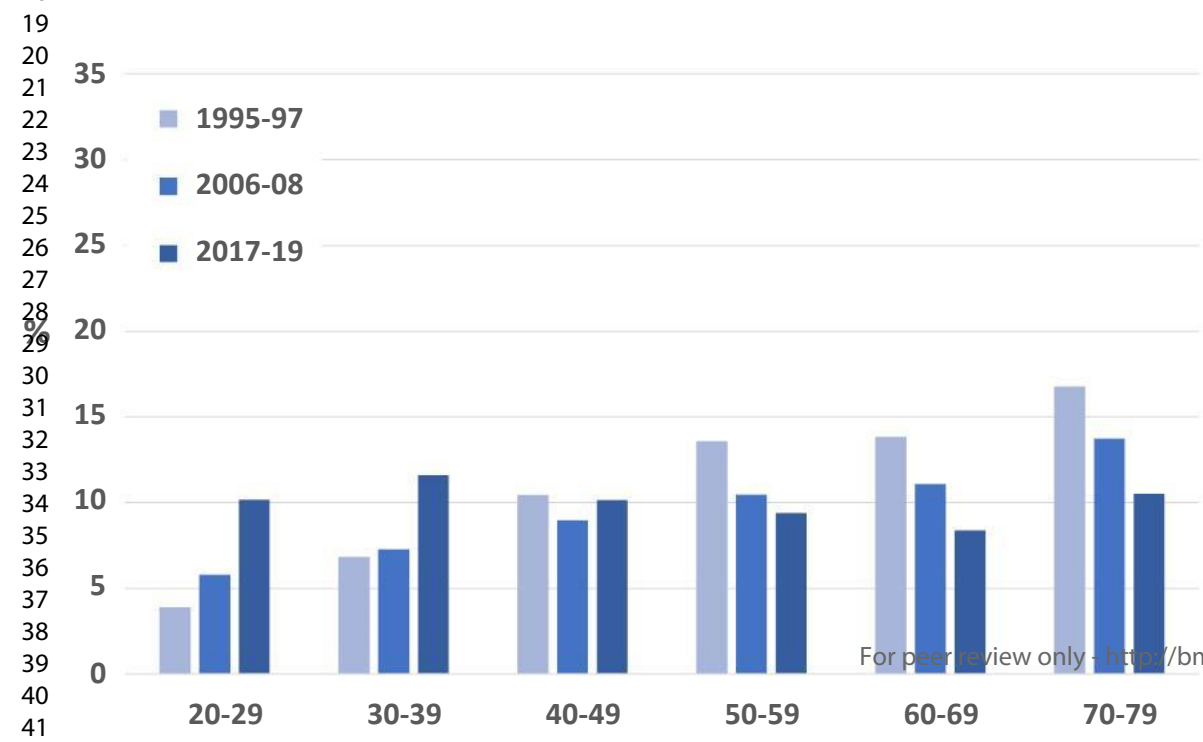
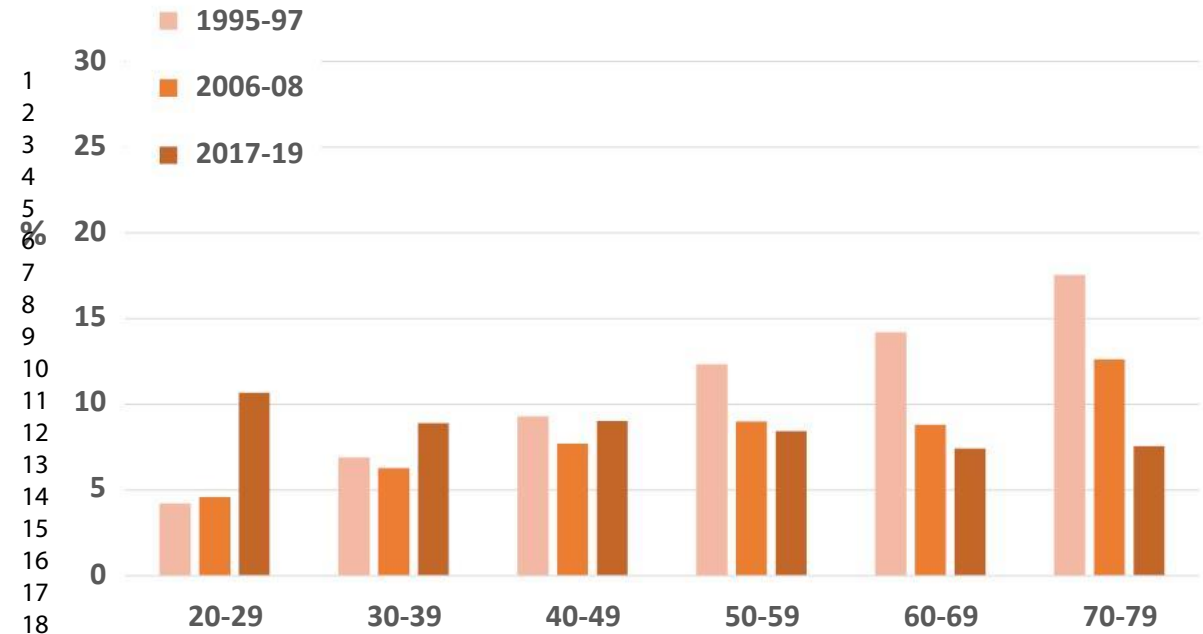
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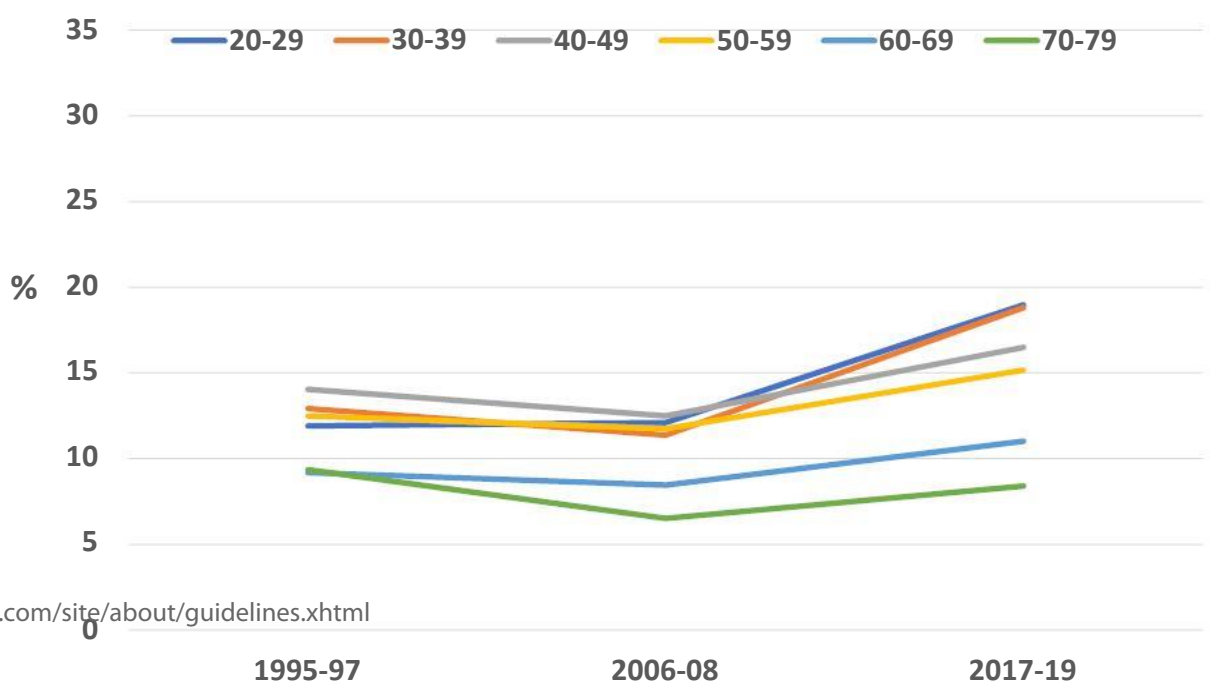
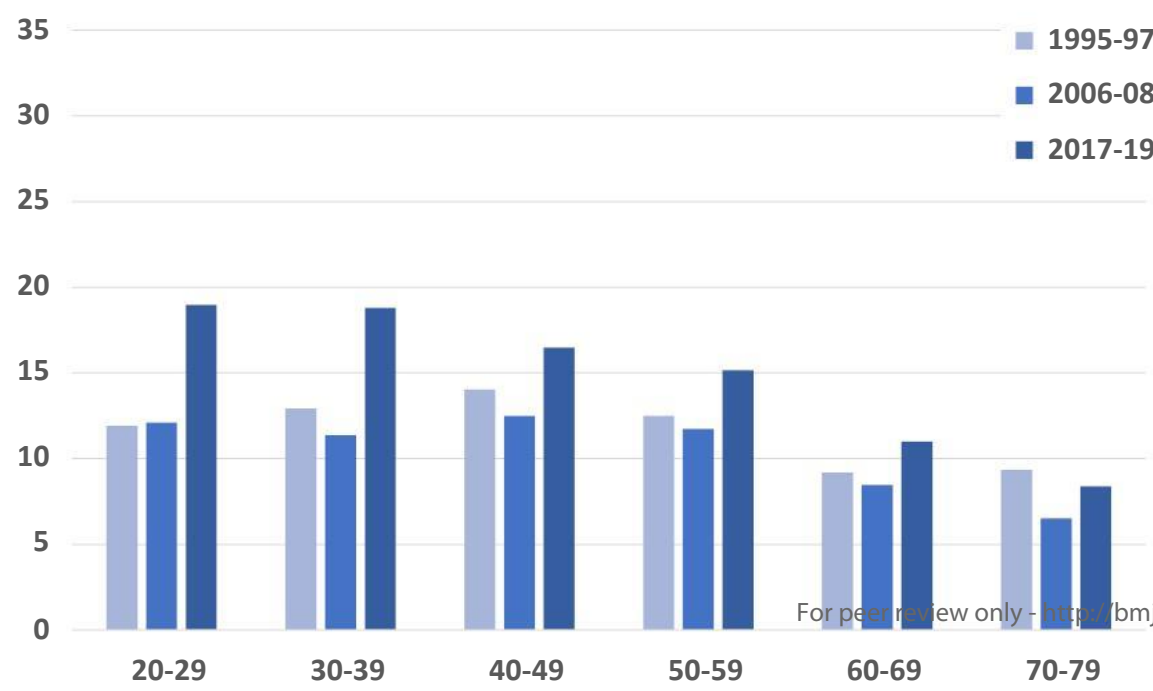
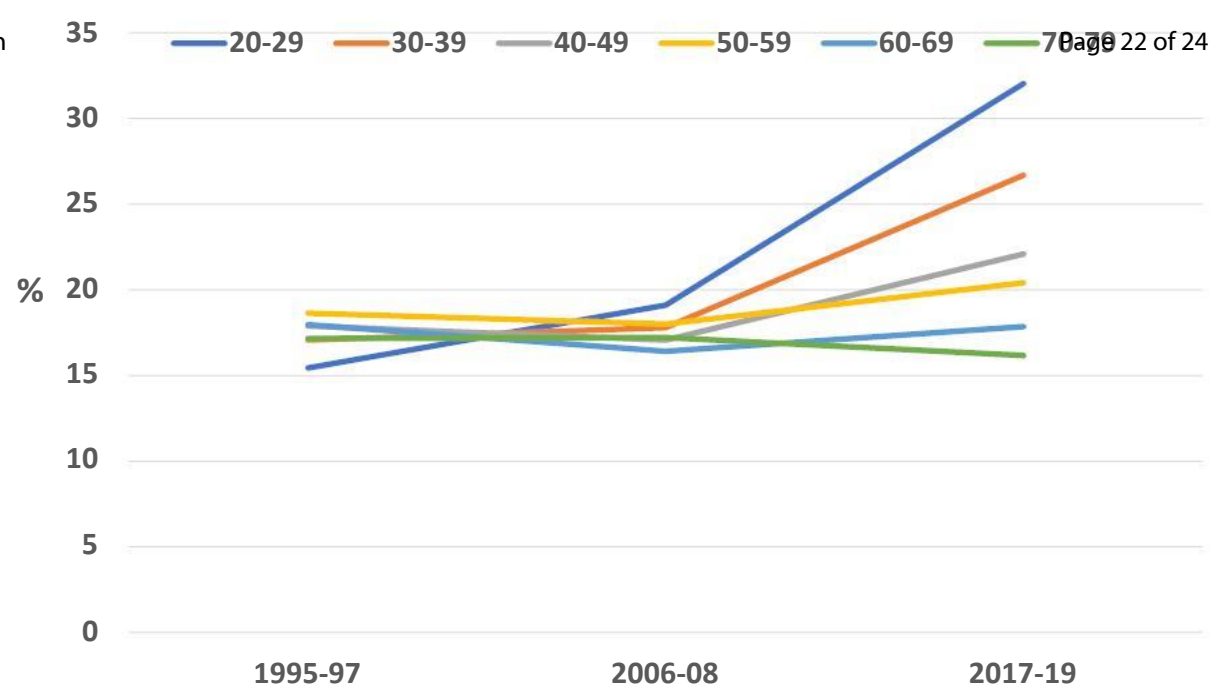
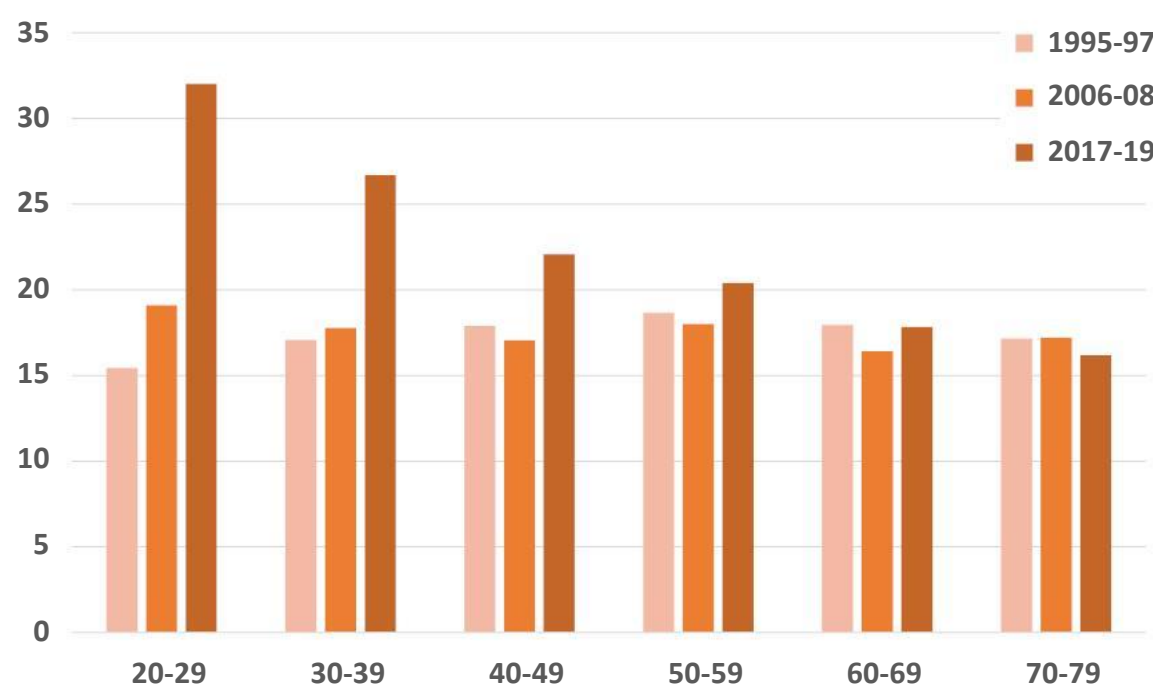


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Appendix table 1

Appendix table 1. Prevalence (%) and 95 percent confidence interval (95% CI) for symptoms of poor mental health by age group and sex.

		HUNT2		HUNT3		HUNT4		P-value for trend	
		Prevalence	95% CI	Prevalence	95% CI	Prevalence	95% CI		
HADS depression									
Women	20-29	4.2	(3.7 - 4.8)	4.6	(3.7 - 5.7)	10.7	(9.5 - 12.0)	0.000	
	30-39	6.9	(6.3 - 7.6)	6.3	(5.5 - 7.2)	8.9	(7.9 - 10.1)	0.004	
	40-49	9.3	(8.6 - 10.0)	7.7	(6.9 - 8.5)	9.0	(8.2 - 10.0)	0.377	
	50-59	12.3	(11.5 - 13.3)	9.0	(8.3 - 9.9)	8.4	(7.7 - 9.3)	0.000	
	60-69	14.2	(13.2 - 15.3)	8.8	(8.0 - 9.7)	7.4	(6.7 - 8.2)	0.000	
Men	70-79	17.5	(16.3 - 18.9)	12.6	(11.4 - 14.0)	7.6	(6.8 - 8.5)	0.000	
	20-29	3.9	(3.3 - 4.5)	5.8	(4.5 - 7.4)	10.2	(8.7 - 11.9)	0.000	
	30-39	6.9	(6.2 - 7.6)	7.3	(6.2 - 8.6)	11.6	(10.2 - 13.2)	0.000	
	40-49	10.4	(9.7 - 11.2)	9.0	(8.0 - 10.0)	10.2	(9.0 - 11.4)	0.358	
	50-59	13.6	(12.7 - 14.6)	10.5	(9.6 - 11.4)	9.4	(8.5 - 10.4)	0.000	
HADS anxiety	60-69	13.9	(12.8 - 15.0)	11.1	(10.2 - 12.1)	8.4	(7.6 - 9.3)	0.000	
	70-79	16.8	(15.4 - 18.2)	13.7	(12.4 - 15.2)	10.5	(9.5 - 11.6)	0.000	
	Women	20-29	15.5	(14.4 - 16.5)	19.1	(17.4 - 21.0)	32.0	(30.1 - 33.9)	0.000
		30-39	17.1	(16.1 - 18.1)	17.8	(16.5 - 19.2)	26.7	(25.1 - 28.4)	0.000
		40-49	17.9	(17.0 - 18.9)	17.1	(16.0 - 18.2)	22.1	(20.8 - 23.4)	0.000
50-59		18.6	(17.5 - 19.8)	18.0	(17.0 - 19.1)	20.4	(19.3 - 21.6)	0.028	
60-69		18.0	(16.7 - 19.3)	16.4	(15.4 - 17.6)	17.9	(16.8 - 19.0)	0.896	
Men	70-79	17.2	(15.7 - 18.8)	17.2	(15.8 - 18.8)	16.2	(15.0 - 17.4)	0.290	
	20-29	11.9	(10.9 - 13.0)	12.0	(10.2 - 14.2)	19.0	(17.0 - 21.2)	0.000	
	30-39	12.9	(12.0 - 13.9)	11.4	(10.0 - 12.9)	18.8	(17.0 - 20.7)	0.000	
	40-49	14.0	(13.2 - 15.0)	12.5	(11.4 - 13.7)	16.5	(15.1 - 18.0)	0.030	
	50-59	12.5	(11.6 - 13.5)	11.7	(10.8 - 12.7)	15.2	(14.0 - 16.4)	0.001	
60-69	9.2	(8.3 - 10.2)	8.5	(7.6 - 9.4)	11.0	(10.1 - 12.0)	0.004		
	70-79	9.4	(8.2 - 10.6)	6.5	(5.6 - 7.6)	8.4	(7.5 - 9.4)	0.325	

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

The following recommendations were followed if applicable for the manuscript: Paradoxical trends in mental health in the society and the root causes of increased mental health problems among young people. The HUNT Study, Norway.

	Item No	Recommendation	Page in manus.
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4-5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4-5
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4-5
Bias	9	Describe any efforts to address potential sources of bias	11
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	4
		(b) Describe any methods used to examine subgroups and interactions	4
		(c) Explain how missing data were addressed	5-6
		(d) If applicable, describe analytical methods taking account of sampling strategy	Na
		(e) Describe any sensitivity analyses	Na
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	4
		(b) Give reasons for non-participation at each stage	4
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	5
		(b) Indicate number of participants with missing data for each variable of interest	5

Outcome data	15*	Report numbers of outcome events or summary measures	5
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6-9
		(b) Report category boundaries when continuous variables were categorized	5-9
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Na
Discussion			
Key results	18	Summarise key results with reference to study objectives	9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9-10, 11-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	10
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Divergent decennial trends in mental health according to age reveal poorer mental health for young people. Repeated cross-sectional population-based surveys from the HUNT Study, Norway

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8 2 **Divergent decennial trends in mental health according to age**
9 **reveal poorer mental health for young people. Repeated cross-**
10 **sectional population-based surveys from the HUNT Study,**
11 **Norway**
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8 Steinar Krokstad (000-0002-2932-6675), Daniel Albert Weiss, Morten Austheim Krokstad, Vegar Rangul, Kirsti Kvaløy, Jo Magne Ingul, Ottar Bjerkeset, Jean Marie Twenge, Erik Reidar Sund.

11 Steinar Krokstad, professor, HUNT Research Centre, Department of Public Health and Nursing, Norwegian University of Science and Technology, 7600 Levanger, Norway.

13 Daniel Albert Weiss, associate professor, Nord University, Faculty of Social Sciences, Universitetsalléen 11, 8026 Bodø, Norway.

15 Morten Austheim Krokstad, PhD Fellow, Faculty of Health Sciences and Nursing, Nord University, 7600 Levanger, Norway.

17 Vegar Rangul, associate professor, HUNT Research Centre, Department of Public Health and Nursing, Norwegian University of Science and Technology, 7600 Levanger, Norway.

19 Kirsti Kvaløy, professor, HUNT Research Centre, Department of Public Health and Nursing, Norwegian University of Science and Technology, 7600 Levanger, Norway.

21 Jo Magne Ingul, psychologist, Levanger Hospital, Nord-Trøndelag Hospital Trust, 7600 Levanger, Norway.

23 Ottar Bjerkeset, professor, Faculty of Health Sciences and Nursing, Nord University, 7600 Levanger, Norway.

25 Jean Marie Twenge, professor, Department of Psychology, College of Sciences, San Diego State University, San Diego, CA 92182-4611, USA.

27 Erik Reidar Sund, senior researcher, HUNT Research Centre, Department of Public Health and Nursing, Norwegian University of Science and Technology, 7600 Levanger, Norway.

30 Correspondence to: Steinar Krokstad (000-0002-2932-6675) steinar.krokstad@ntnu.no

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34 Abstract

35 **Objectives.** Public health trends are formed by political, economic, historical, and cultural factors in
36 society. The aim of this paper was to describe overall changes in mental health among adolescents
37 and adults in a Norwegian population over the three last decades and discuss some potential
38 explanations for these changes.

39 **Design.** Repeated population-based health surveys to monitor decennial changes.

40 **Setting.** Data from three cross-sectional surveys in in 1995-97, 2006-08 and 2017-19 in the
41 population-based HUNT Study in Norway were used.

42 **Participants.** The general population in a Norwegian County covering participants aged 13 to 79
43 years, ranging from 48 000 to 62 000 in each survey.

44 **Main outcome measures.** Prevalence estimates of subjective anxiety and depression symptoms
45 stratified by age and gender were assessed using the Hopkins Symptom Check-List 5 (HSCL-5) for
46 adolescents and the Hospital Anxiety and Depression Scale (HADS) for adults.

47 **Results.** Adolescents' and young adults' mental distress increased sharply, especially between 2006-
48 08 and 2017-19. However, depressive symptoms instead declined among adults ages 60 and over
49 and anxiety symptoms remained largely unchanged in these groups.

50 **Conclusions.** Our trend data from the HUNT Study in Norway indicate poorer mental health among
51 adolescents and young adults that we suggest are related to relevant changes in young people's
52 living conditions and behavior, including the increased influence of screen-based media.

53

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56 Strengths and limitations of this study

- 57 ➤ The HUNT Study is a large general county population health survey repeated every decade since
58 the 1980s in Norway, suitable for following trends in public health
- 59 ➤ The total population 13+ years are invited to complete the survey
- 60 ➤ Identical screening tools for measuring anxiety and depression symptoms have been used in all
61 three surveys covered by this article; Hopkins Symptoms Check List 5 for adolescents and
62 Hospital Anxiety and Depression Scale for adults
- 63 ➤ Data covered approximately 78% of the total adolescent population and 54% to 70% of the total
64 adult population with the risk of selection bias
- 65 ➤ Changes in socio-cultural and behavioral attitudes towards depression, anxiety, and mental
66 health in general in recent years may have made it easier for participants to report mental
67 health concerns in questionnaires that may have introduced some reporting bias.

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70 Introduction

71 Mental health problems are among the leading causes of disease burden worldwide.^{1,2} Further,
72 mental health issues are primary drivers of disability worldwide, causing over 40 million years of
73 disability in 20 to 29-year-olds.³ Depression alone accounts for more disability-adjusted life years
74 (DALYs) than all other mental disorders together⁴ and is projected to become the leading cause of
75 disability in high-income countries by 2030.⁵ Thus, the public health burden of mood disorders is
76 substantial, with negative effects including functional problems, reduced quality of life, disability,
77 low work productivity, increased mortality, and increased health care utilization.

78 In Norway, estimates of years lived with disability in 2016 display anxiety and depression ranked as
79 number four and seven on the list of the most contributing diseases in the Global Burden of Disease
80 statistics.⁶ Mental disorders are highly prevalent in disability benefit statistics, with awards often
81 granted at younger ages than for other diagnoses. Mental disorders have additionally been shown to
82 be responsible for the most working years lost (33.8%) of any disability.⁷

83 During the last decade, rates of depressive symptoms have increased in several adolescent
84 populations.⁸⁻¹⁰ In the USA, rates of depression, self-harm, and suicide attempts increased
85 substantially in adolescents after 2010.¹¹⁻¹³ On the other hand, data have paradoxically shown an
86 improvement in mental health with age indicating the opposite trend among older people.^{14,15}

87 Several prominent research-based theories and models, which have provided significant support to
88 modern understanding and practice of health promotion and disease prevention, may offer insights
89 into understanding the causes of current trends in mental health. The World Health Organization's
90 Commission on the Social Determinants of Health (SDH), for example, defined the SDH as "the
91 conditions in which people are born, grow, live, work and age" as the fundamental drivers of public
92 health.¹⁶ Thus, when observing emerging trends in population health, it is important to look at the
93 underlying conditions that may drive the changes. The eminent epidemiologist Geoffrey Rose
94 stressed that the determinants of individual cases and the determinants of incidence rates are two
95 different issues. The second seeks the causes of changing incidence of health problems in the
96 population.¹⁷ This theory argues that political, economic, historical, and cultural trends in Western
97 societies may have affected mental health by influencing changes in social living conditions.
98 Neoliberalism has been the dominating political ideology in Europe and US since the 1980s.
99 Economic growth has been the main priority of the neoliberal agenda, together with the
100 deregulation of economies, forcing open national and international markets to trade.¹⁸ This has
101 contributed to major changes in the living conditions of groups in societies around the world,
102 including young people. For many, optimism and the belief in economic growth and improved
103 quality of life have been replaced by concerns about climate change, growing social injustice, threats
104 to democracy and the threat of technological developments leading to increased exploitation and
105 potentially magnifying many of these other concerns.¹⁹ These concerns have become particularly
106 visible for young people growing up in many western, developed societies.

107 It has become increasingly apparent that the rapidly growing global unregulated information
108 technology sector collects and mines enormous amounts of data on individuals.²⁰ The term *dataism*
109 is used to describe the mindset or philosophy created by this trend. Recently, the term has been
110 expanded to describe what others, including leading historian Yuval Noah Harari and leading social
111 psychologist Shoshana Zuboff, has called an emerging form of capitalism, ideology, or even a new
112 form of religion.^{20,21} The increase in global interactions has caused a growth in international trade
113 and the exchange of ideas and culture. Consumerism, the increasing polarization due to so-called
114 technologically produced "echo-chambers" in digitally mediated spaces of social interaction are but

1
2
3 115 a few of the trends influencing these developments.²² Taking selfies, and along with that, improving
4 116 our image for public consumption have become regular in younger generations.²³

6 117 Driven by these societal and technological trends, the use of the internet began to increase in the
7 118 early 2000s, and smartphones after 2010. Social media also became more popular after 2010. These
8 119 trends may have had a significant impact on human behavior, especially among adolescents and
9 120 young adults. In several large studies, heavy users of such technologies are more likely to be
10 121 depressed^{9 24} or have lower levels of well-being.^{9 25} Similarly, the HUNT Study of Norway have shown
11 122 associations between the number of hours of screen time and increased anxiety and depression
12 123 symptoms , which was particularly strong in girls when screen time predominantly involved the use
13 124 of social media and internet. ²⁶ Declines in face-to-face social interaction among adolescents may
14 125 also impact even non-users of digital media, increasing the need for social assurance and reducing
15 126 opportunities for in-person social interaction.²⁷ However, the need for social assurance fueled by
16 127 excessive smartphone use is often not gratified, and eventually leads to greater loneliness.²⁸ Some
17 128 evidence suggests that increased time spent using these technologies and, more generally, exposure
18 129 to the evolving modern technological environment may be causes of the sudden increase in
19 130 depression since 2010.¹¹ Stronger associations between digital media time and mental health
20 131 indicators have been shown in girls compared to boys, perhaps because social media, used more
21 132 frequently by girls, is more strongly linked to depression than gaming, used more frequently by
22 133 boys.⁹ Furthermore, research on adolescents in Norway has associated psychiatric problems with
23 134 sleep quality problems, which are exacerbated by the use of social media and computer gaming
24 135 among adolescents.²⁹⁻³¹ In addition, higher academic pressure following the dominant political
25 136 preoccupation with competition and a credentials-based labor market influencing educational
26 137 programs may also have increased mental distress among adolescents and students.^{32 33} A
27 138 Norwegian study has shown a clear decline in young peoples' reporting of happiness and life
28 139 satisfaction over the last ten years. The study showed that increasing concern about the future
29 140 contributed most to the decline. This concern was related to fears of various adverse events, such as
30 141 future job opportunities and one's own financial situation. Other conditions such as dissatisfaction
31 142 with social relationships, health, physical fitness and body also had significance.³⁴

32 143 The aim of this paper was to describe the parallel changes in mental health among adolescents and
33 144 adults in a Norwegian population over the three last decades and suggest some potential
34 145 explanations for these changes based on theories related to the social determinants of health.^{16 17}

35 146

36 147 **Methods**

37 148 The data were taken from three different waves in the Trøndelag Health Study (HUNT), Young-
38 149 HUNT1 and HUNT2 (1995-97), Young-HUNT3 and HUNT3 (2006-08) and Young-HUNT4 and HUNT4
39 150 (2017-19)(figure 1).³⁵ The invited participants were the total population in the Nord-Trøndelag
40 151 County area aged 13-19 years (Young-HUNT) and 20+ years (HUNT).³⁶ The numbers and attendance
41 152 rates are shown in figure 1. The samples ranged from 8980 to 8066 adolescent participants and from
42 153 62 444 to 48 362 adult participants.

43 154

44 155 **Figure 1.** Data collected in the HUNT Study, Norway. Number of participants and response rates.^{35 36}

45 156

Data from the different decades were stratified by age and sex. In the Young-HUNT surveys, we applied the Hopkins Symptom Checklist–5 (SCL-5). Hopkins Symptom Checklist–25 (SCL-25) is a widely applied self-report measure of anxiety and depression symptoms. Compared with the SCL-25, the short form model fit is good and correlations with established measures demonstrate convergent validity.^{37 38} Prevalence (%) of anxiety and depression symptoms were measured with SCL-5 (cut-off ≥ 2). For adults, we applied the Hospital Anxiety and Depression Scale (HADS). The HADS is a brief 14-item self-report questionnaire, consisting of seven items for the anxiety subscale (HADS-A) and seven for the depression subscale (HADS-D), each scored on a Likert-scale from 0 (no symptoms) to 3 (symptoms maximally present). For this study, valid ratings of the HADS-D and HADS-A were defined as at least five completed items on both subscales. The score of those who filled in five or six items was based on the sum of completed items multiplied with 7/5 or 7/6, respectively. We used the conventional cut-off threshold of ≥ 8 for the HADS subscales. This cut off value is found to provide optimal sensitivity and specificity (about 0.80) and a good correlation with the case of clinical depression based on DSM-III and ICD–8/9 diagnostic criteria [34]. HADS is found to perform well in assessing the symptom severity and case categorization of anxiety and depressive disorders in the general population and in somatic, psychiatric and primary care patients.³⁹ Results are reported as prevalence (in %) along with 95 per cent confidence intervals (95% CI) and we also report p-values for linear trend according to time. Data management and analyses were done with Stata v. 16.⁴⁰

Patient and public involvement

Public stakeholders and patient organizations have been involved in the planning of all HUNT surveys. No patients were involved in the design or implementation of this specific study. As the study used previously collected data, we did not ask patients or the public to assess the burden of participation. Public stakeholders and patient organizations are involved in dissemination of results from the HUNT Study.

Ethical approval

This study was approved by the Regional Committees for Medical and Health Research Ethics; REC south-east, Norway 196364/2020. All participants gave informed consent before taking part in the HUNT Study.

Results

The percentage of adolescents screening positive for anxiety and depression nearly doubled between 1995-97 and 2017-19, from 15.3% to 29.8%, with most of the increase occurring between 2006-08 and 2017-19 (see Table 1).

Table 1. Characteristics for the sample aged 13-19 years. The Young-HUNT Study.³⁶

		Young HUNT1 1995-97		Young HUNT3 2006-08		Young HUNT4 2017-19	
		N	%	N	%	N	%
Age	13-19 y	8980	100	8199	100	8066	100
Sex							
	Girls	4463	49.7	4128	50.4	4106	50.9
	Boys	4517	50.3	4071	49.6	3960	49.1

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SCL-5*

Low	7412	82.5	6441	78.6	5410	67.1
High	1372	15.3	1520	18.5	2404	29.8
Missing	196	2.2	238	2.9	252	3.1
Total	8980	100	8199	100	8066	100

*Hopkins Symptom Checklist-5 (SCL-5) cut-off ≥ 2 .

The percentage of adults screening positive for depression declined from 9.4% in 1995-97 to 6.7% in 2017-19, and the percentage screening positive for anxiety increased from 12.4% in 1995-97 to 13.4% in 2017-19 (see Table 2).

Table 2. Characteristics for the sample aged 20-79 years. The HUNT Study.³⁵

	HUNT2 (1995-97)		HUNT3 (2006-08)		HUNT4 (2017-19)	
	N	(%)	N	(%)	N	(%)
Age groups						
20-29 y	9111	(14.6)	4511	(9.3)	6428	(12.3)
30-39 y	11630	(18.6)	6859	(14.2)	6755	(12.9)
40-49 y	13603	(21.8)	10012	(20.7)	9002	(17.2)
50-59 y	11058	(17.7)	11425	(23.6)	10761	(20.5)
60-69 y	9048	(14.5)	9801	(20.3)	11186	(21.3)
70-79 y	7994	(12.8)	5754	(11.9)	8310	(15.9)
Sex						
Females	32991	(52.8)	26316	(54.4)	28488	(54.3)
Males	29453	(47.2)	22046	(45.6)	23954	(45.7)
HADS Depression*						
Low	51049	(81.8)	34301	(70.9)	35271	(67.3)
High	5855	(9.4)	3453	(7.1)	3505	(6.7)
Missing	5540	(8.9)	10608	(21.9)	13666	(26.1)
HADS Anxiety*						
Low	44462	(71.2)	32192	(66.6)	31594	(60.3)
High	7736	(12.4)	5387	(11.1)	7004	(13.4)
Missing	10246	(16.4)	10783	(22.3)	13844	(26.4)
Total	62444	(100)	48362	(100)	52442	(100)

* Hospital Anxiety and Depression Scale (HADS) cut-off ≥ 8 .

Table 3 shows the trends in prevalence (%) and 95 % confidence interval (95 % CI) for symptoms of poor mental health by age group and sex. Among adolescents, the prevalence of anxiety and depression symptoms above the recommended cut-off on the SCL-5 scale³⁸ was 10.2% for boys and 21.1% for girls in the 1990s. In the latest survey (2017-19), the prevalence had changed to 16.5% for boys and 44.4% for girls, i.e. particularly large change in the last ten years for girls (figure 2).

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Table 3. Prevalence (%) and 95 per cent confidence interval (95% CI) for symptoms of anxiety and depression by age group and sex. The HUNT Study, Norway.

Adolescents		Young-HUNT1 1995-97		Young-HUNT3 2006-08		Young-HUNT4 2017-19		P-value for trend
		Prevalence	95% CI	Prevalence	95% CI	Prevalence	95% CI	
SCL-5*								
Girls	13-19	21.1	(19.9- 22.3)	27.3	(26.0- 28.7)	44.4	(42.8- 45.9)	0.000
Boys	13-19	10.2	(9.3- 11.1)	10.6	(9.7- 11.6)	16.5	(15.4- 17.7)	0.000
Adults		HUNT2		HUNT3		HUNT4		
HADS depression**								
Females	20-29	4.2	(3.7 - 4.8)	4.6	(3.7 - 5.7)	10.7	(9.5 - 12.0)	0.000
	30-39	6.9	(6.3 - 7.6)	6.3	(5.5 - 7.2)	8.9	(7.9 - 10.1)	0.004
	40-49	9.3	(8.6 - 10.0)	7.7	(6.9 - 8.5)	9.0	(8.2 - 10.0)	0.377
	50-59	12.3	(11.5 - 13.3)	9.0	(8.3 - 9.9)	8.4	(7.7 - 9.3)	0.000
	60-69	14.2	(13.2 - 15.3)	8.8	(8.0 - 9.7)	7.4	(6.7 - 8.2)	0.000
	70-79	17.5	(16.3 - 18.9)	12.6	(11.4 - 14.0)	7.6	(6.8 - 8.5)	0.000
Males	20-29	3.9	(3.3 - 4.5)	5.8	(4.5 - 7.4)	10.2	(8.7 - 11.9)	0.000
	30-39	6.9	(6.2 - 7.6)	7.3	(6.2 - 8.6)	11.6	(10.2 - 13.2)	0.000
	40-49	10.4	(9.7 - 11.2)	9.0	(8.0 - 10.0)	10.2	(9.0 - 11.4)	0.358
	50-59	13.6	(12.7 - 14.6)	10.5	(9.6 - 11.4)	9.4	(8.5 - 10.4)	0.000
	60-69	13.9	(12.8 - 15.0)	11.1	(10.2 - 12.1)	8.4	(7.6 - 9.3)	0.000
	70-79	16.8	(15.4 - 18.2)	13.7	(12.4 - 15.2)	10.5	(9.5 - 11.6)	0.000
HADS anxiety**								
Females	20-29	15.5	(14.4 - 16.5)	19.1	(17.4 - 21.0)	32.0	(30.1 - 33.9)	0.000
	30-39	17.1	(16.1 - 18.1)	17.8	(16.5 - 19.2)	26.7	(25.1 - 28.4)	0.000
	40-49	17.9	(17.0 - 18.9)	17.1	(16.0 - 18.2)	22.1	(20.8 - 23.4)	0.000
	50-59	18.6	(17.5 - 19.8)	18.0	(17.0 - 19.1)	20.4	(19.3 - 21.6)	0.028
	60-69	18.0	(16.7 - 19.3)	16.4	(15.4 - 17.6)	17.9	(16.8 - 19.0)	0.896
	70-79	17.2	(15.7 - 18.8)	17.2	(15.8 - 18.8)	16.2	(15.0 - 17.4)	0.290
Males	20-29	11.9	(10.9 - 13.0)	12.0	(10.2 - 14.2)	19.0	(17.0 - 21.2)	0.000
	30-39	12.9	(12.0 - 13.9)	11.4	(10.0 - 12.9)	18.8	(17.0 - 20.7)	0.000
	40-49	14.0	(13.2 - 15.0)	12.5	(11.4 - 13.7)	16.5	(15.1 - 18.0)	0.030
	50-59	12.5	(11.6 - 13.5)	11.7	(10.8 - 12.7)	15.2	(14.0 - 16.4)	0.001
	60-69	9.2	(8.3 - 10.2)	8.5	(7.6 - 9.4)	11.0	(10.1 - 12.0)	0.004
	70-79	9.4	(8.2 - 10.6)	6.5	(5.6 - 7.6)	8.4	(7.5 - 9.4)	0.325

*Hopkins Symptom Checklist-5 (SCL-5) cut-off ≥ 2 .

** Hospital Anxiety and Depression Scale (HADS) cut-off ≥ 8 .

Figure 2. Prevalence (%) of anxiety and depression symptoms measured with SCL-5 (cut-off ≥ 2), from three decades of adolescents in the Young-HUNT Study.

For adults, table 3 shows that an increasing prevalence for depressive symptoms above cut-off with age was observed in both sexes, from around four percent among young adults 20-29 years and around 17% among older people 70-79 years in 1995-97 (figure 3). In contrast to this, the highest

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219 prevalence among young women (10.7%), and the lowest among the elderly aged 70-79 (7.6%) were
220 observed in the last survey (2017-19) (figure 3).

221

222 **Figure 3.** Prevalence (%) of depression symptoms measured with HADS-D (cut-off ≥ 8) from three
223 decades, the HUNT Study.

224

225 The prevalence of anxiety symptoms above cut-off measured with HADS-A was similar in all age
226 groups in 1995-97 (table 3); around 10% for men and 17% for women. In the last survey, we
227 observed a markedly higher prevalence of anxiety symptoms for both genders for participants aged
228 20-39 years (figure 4).

229

230 **Figure 4.** Prevalence (%) of anxiety symptoms measured with HADS-A (cut-off ≥ 8) from three
231 decades, the HUNT Study.

232

233 The negative trends among young adults and the positive trends among older participants shown in
234 figures 3 and 4 were statistically significant in almost all groups (appendix table 1).

235

236 Discussion

237 Results from the large Norwegian population-based HUNT Study of more than 170,000 people
238 showed large increases in the prevalence of anxiety and depression symptoms among adolescents
239 and young adults since the 1990s, especially between 2006-08 and 2017-19. These increases were
240 largest among young women, though there were also increases among young men. In contrast,
241 among older adults rates of depressive symptoms declined, and anxiety symptoms remained largely
242 unchanged.

243

244 *Possible reasons for change*

245 An important question is whether the increases in anxiety and depression symptoms reported were
246 influenced by changes in socio-cultural and behavioral attitudes towards anxiety, depression, and
247 mental health in general. In recent years, mental health among young people has received increased
248 attention in the Norwegian society. As a result, it may have become easier for young participants to
249 report anxiety and depression symptoms and express emotion in questionnaires. For the adult
250 participants, we have used a different tool than for adolescents (HADS), however, the exact same
251 trend for participants aged 20-39 years as in adolescents was identified. The opposite trend was
252 observed for the elderly. The fact that two different instruments present similar trends among
253 young people in our sample, and the divergent trends by age, supports the validity of our findings. In
254 addition, results are supported by data from the Norwegian health services and prescription
255 databases, clearly demonstrating increasing numbers of individuals either referred for, or in need of
256 treatment for mental illness among young people.⁴¹ The increase in reported anxiety and depression
257 symptoms demonstrated in our data, is also accompanied by an increasing number of adolescents in
258 the general population referred to mental health services,⁴² an increased use of psychotropic drugs

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1
2
3 259 in age groups reporting increasing symptoms,⁴³ and an increasing number of young adults in need of
4 260 social welfare.⁴⁴ In addition, similar increases in mental health issues in countries such as the U.S.
5 261 have been accompanied by concurrent increases in hospital admissions for self-harm behaviors and
6 262 suicide attempts that cannot be attributed to changes in survey self-reports.^{45 46} Consistent with the
7 263 changes we see in our Norwegian data, a clear decline in young people's happiness and life
8 264 satisfaction over the last ten years has been reported as well.³⁴

11 265 Thus, taken together, evidence seems to suggest that the observed trends in poorer mental health
12 266 among young people are real. To determine the causes behind such public health trends is, however,
13 267 challenging. Younger generations clearly face concerns that have increased in significance and
14 268 importance throughout the previous few decades. These include worsening climate change, growing
15 269 social injustice,⁴⁷ emerging threats to democratic institutions and the propagation of consequences
16 270 related to the advent of innovative modern technological developments.¹⁹ In addition, higher
17 271 academic pressure reflects the dominant neoliberal political preoccupation with competition.³³
18 272 When young people's sense of self-worth is dependent on what they achieve in school, it can also
19 273 lead to anxiety and depression if they do not achieve expected results.³²

22 274 Another substantial change in Western societies during the last decade, and which we believe may
23 275 have great significance, has been in technology use. The tech industry's strong influence on young
24 276 people's behavior using deliberately manipulative and exploitive strategies may be an important
25 277 driver of the observed trends among young people in our data.¹¹ Growing use of social media as a
26 278 daily activity has led to the emergence of ethical concerns related to the management of data.⁴⁸
27 279 Several studies have demonstrated the mechanisms of addiction to electronic devices used to access
28 280 these digital ecosystems.^{20 49} Addiction to social networks is a consequence of users' fear of missing
29 281 out, feeling that they have an impact on others, and make them feel an instant reward when they
30 282 publish content about themselves.⁴⁸ Evidence has shown that heavy users of social media, for
31 283 example, are twice as likely as light users to be depressed or report lower levels of well-being.¹¹
32 284 These effects may be associated with an increase in the prevalence of loneliness seen after 2012^{28 50}
33 285 and reduced hours of sleep among adolescents.^{29 30} Some have questioned the suggestion that
34 286 increased time spent on social media is a leading cause of adverse mental health among young
35 287 people, with individual data revealing only a weak association between time use and mental health
36 288 in a longitudinal study.⁵¹ However, associations at the individual level may be different from the
37 289 group-level associations we examine here; even non-users of technology may be impacted by the
38 290 changes in social interaction caused by technology use.¹¹ The increased acceptance, integration and
39 291 near-obligatory use of internet-based media technologies to access services and social networks in
40 292 society increasingly either isolate non-users or force them to conform. Furthermore, as social norms
41 293 move away from in-person social interaction, even individuals interested in in-person interactions
42 294 find it increasingly difficult to find others to do so with. Social media is social, not just individual, and
43 295 naturally possesses powerful network effects.²⁷ Thus, it becomes necessary to look further into the
44 296 political, historical and cultural context in which these behavioral changes unfold.^{17 52}

51 297 Among older segments of the population, we see no similar increase in mental health issues over the
52 298 study period. In fact, our results highlight rather the opposite – improved mental health. Such trends
53 299 have also been observed in other populations.¹⁴ National survey data in Norway shows that social
54 300 media use follows a consistent age gradient, with younger populations showing considerably more
55 301 use of social media daily compared to older.⁵³ Older people in Norway benefit from good living
56 302 conditions with financial security in a generous welfare state⁵⁴ and good prospects of high life
57 303 expectancy.⁵⁵ Older individuals may also benefit from emotional regulation and complex social

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304 decision-making, and thus be able to cope with the stress of technological developments in other
305 ways than young people.^{14 56}

306

307 *Strengths*

308 The HUNT Study collects data from a total population at approximately ten years intervals, enabling
309 studies of health changes in the population over time.^{35 36} The invitation/sampling of participants,
310 and methods for measuring mental health, have been conducted using the same methods and
311 instruments in all three surveys included in the present study. Large sample sizes have ensured
312 reliable estimates. Health trends in the county follow both national⁵⁷ and international western
313 health trends closely.⁵⁸ The population is stable and relatively homogenous with a low net migration.
314 As part of a national Nordic welfare state, the population recruited is part of a country with a
315 universal public health service and a school system where almost everyone attends the same local
316 schools.

317

318 *Limitations*

319 Our survey data covered approximately 78% of the total adolescent population and 70% to 54% of
320 the total adult population (as the result of a decrease in participation from HUNT2 to HUNT3 among
321 adults). Non-response analyzes for adult participants have shown that those who choose not to
322 participate generally have a higher mortality rate, slightly higher prevalence of chronic illness, and
323 lower socioeconomic position than participants.⁵⁹ This may have biased our findings so that
324 unfavorable trends among adolescents are underestimated and favorable trends among adults are
325 overestimated. The study design does not allow for causal inferences.

326

327 *Relevance*

328 The tech industry's strong influence on young people's behavior has taken place without notable
329 political concern in Norway or other western countries, in line with dominating neoliberal political
330 ideology.^{18 60} This has allowed the rapid expansion of innovative technologies by commercial and
331 corporate actors to facilitate the exploitation of spheres of society relatively untouched by capitalist
332 interests before the emergence of these technologies. The consequences are, however, not going
333 completely unrecognized, and awareness is growing, in part represented by an emerging discussion
334 and appreciation for addressing the power and influence of commercial⁶¹ and corporate
335 determinants of health.⁶²

336 Our results are in line with results suggesting poorer mental health observed among adolescents and
337 young adults internationally^{8 9} and, more specifically, in the USA.¹¹ Supporting research shows,
338 additionally, that social media use has significant effects on mental health, particularly in young
339 people.²⁵ The data on both are of great interest to public health policy. The undesirable trend has
340 affected many young people and affected everyday life substantially for large groups in Norway.
341 Based on earlier findings from the HUNT Study, there is reason to forecast that poorer mental health
342 may contribute to an increasing incidence of work-related incapacity in Norway now and in the years
343 to come.^{6 63}

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345 *Need for further research and need for action*

346 Our findings highlight the need for further research to find out if some of the reductions in mental
347 health simply may be due to greater awareness of mental health or changes in reporting. It is,
348 furthermore, necessary to investigate the broad range of potential driving factors underlying
349 increased mental health problems in young people. The long-term consequences will be important
350 to follow, to see if the correlation between poorer mental health in adolescents and negative
351 outcomes in adulthood will be as expected based on previous studies.⁶³ Based on what is outlined in
352 this paper, there is every reason to consider policy measures to protect youth and young adults
353 against increasing mental distress. A public health policy is needed that strengthens faith in the
354 future, demonstrating our influence on living conditions and reduced pressure and stress on young
355 people. Experience and evidence from population-based public health and relevant research,
356 provides reason to believe that increased regulation of the tech industry, which has enjoyed
357 relatively few restrictions for decades, will be important moving forward. Governments and
358 individuals could challenge their role in defining the dominant narrative, setting the rules by which
359 trade operates, commodifying knowledge and undermining political, social, and economic rights in
360 our society.⁶² Relevant measures could be, but are not limited to, an enforced age minimum for use
361 of social media and online computer gaming, creating increased accountability for the content
362 published by technology companies and their platforms, regulations to restrict addictive elements of
363 different software, and taxation of the industry to obtain funding for relevant public health
364 initiatives. However, of greatest concern is restructuring and regulating the entire economic
365 business model on which many of these tech giants not only depend on for their enormously
366 powerful profits but have also had a central role in developing for the deliberate manipulation and
367 exploitation of its most vulnerable users. Such measures would undoubtedly increase effectiveness
368 through systematic international cooperation. In addition, the effects of climate change and global
369 economic policy and academic pressure as a result of dominant political ideology, also should be
370 further investigated.⁵²

372 *Conclusion*

373 The data from the HUNT Study in Norway indicate a strong increase in anxiety and depression
374 symptoms among adolescents and young adults, and the opposite trend among the elderly. This
375 trend is likely related to significant disruptions in the living conditions of young people in society and
376 behavioral changes in adolescents and young adults, which we suggest are likely driven by major
377 socio-political trends, such as the growth of neoliberal policy, globalization and an expanding tech
378 industry.²¹ The results of this study show that is urgently important that health authorities now see
379 the need to implement significant political measures to address the underlying trends in mental
380 health, and their causes, seen in young people.

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387

388 Contributor statement

389 SK was the main author and contributed to the conception and design of the work, acquisition of
390 data, interpretation of data, drafting and revising it critically for important intellectual content. DAW
391 contributed to interpretation of data, drafting and revising the work critically for important
392 intellectual content. MAK contributed to the conception and design, revising the work critically for
393 important intellectual content, interpretation of data, and revising it critically for important
394 intellectual content. VR contributed to the acquisition of data, analyses and interpretation of data,
395 and revising the work critically for important intellectual content. KK contributed to acquisition of
396 data, interpretation of data, drafting and revising the work critically for important intellectual
397 content. JMI contributed to acquisition of data, interpretation of data, and revising the work
398 critically for important intellectual content. OB contributed to acquisition of data, interpretation of
399 data, and revising the work critically for important intellectual content. JMT contributed to
400 interpretation of data, drafting and revising the work critically for important intellectual content. ERS
401 contributed to the conception and design of the work, acquisition of data, analyses and
402 interpretation of data, drafting and revising it critically for important intellectual content. All authors
403 approved the final version to be published and are accountable for all aspects of the work. SK
404 accepts full responsibility for the work and/or the conduct of the study, had access to the data, and
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412 Competing interests

413 All authors have completed the Unified Competing Interest form (available on request from the
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423 take responsibility for the integrity of the data and the accuracy of the data analysis.

424 Data sharing statement

425 Data sharing: The data used is individual-based sensitive health data that can not be made available
426 without violating the consent and Norwegian law. Data from the Trøndelag Health Study (HUNT) is
427 available upon reasonable request to the HUNT data access committee (hunt@medisin.ntnu.no).

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3 428 The HUNT data access information (www.ntnu.edu/hunt/data) describes in detail the policy about
4 429 data availability.

6 430 Transparency: The lead author (SK) affirms that the manuscript is an honest, accurate, and
7 431 transparent account of the study being reported; that no important aspects of the study have been
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10 433

13 434 References

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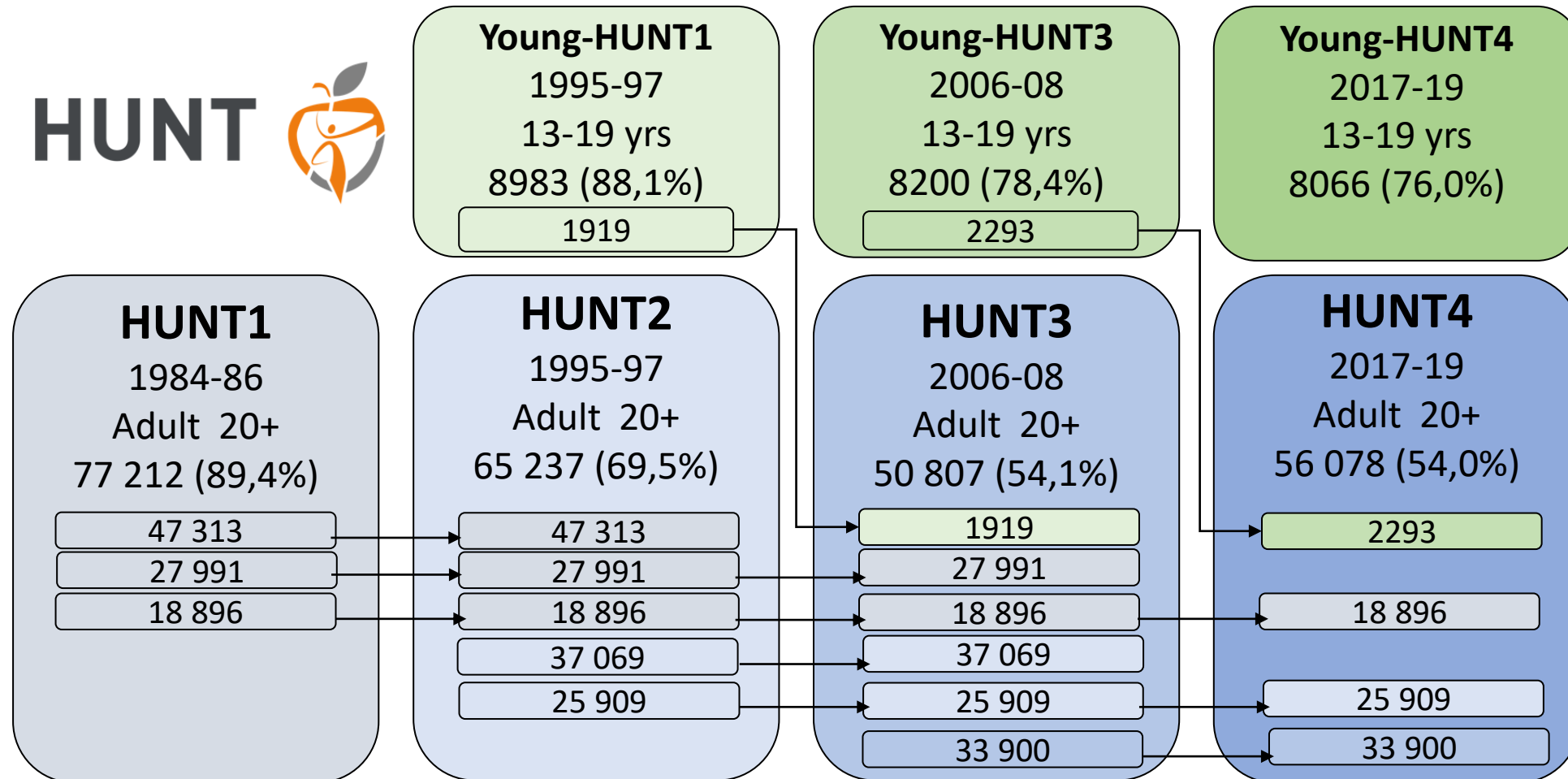
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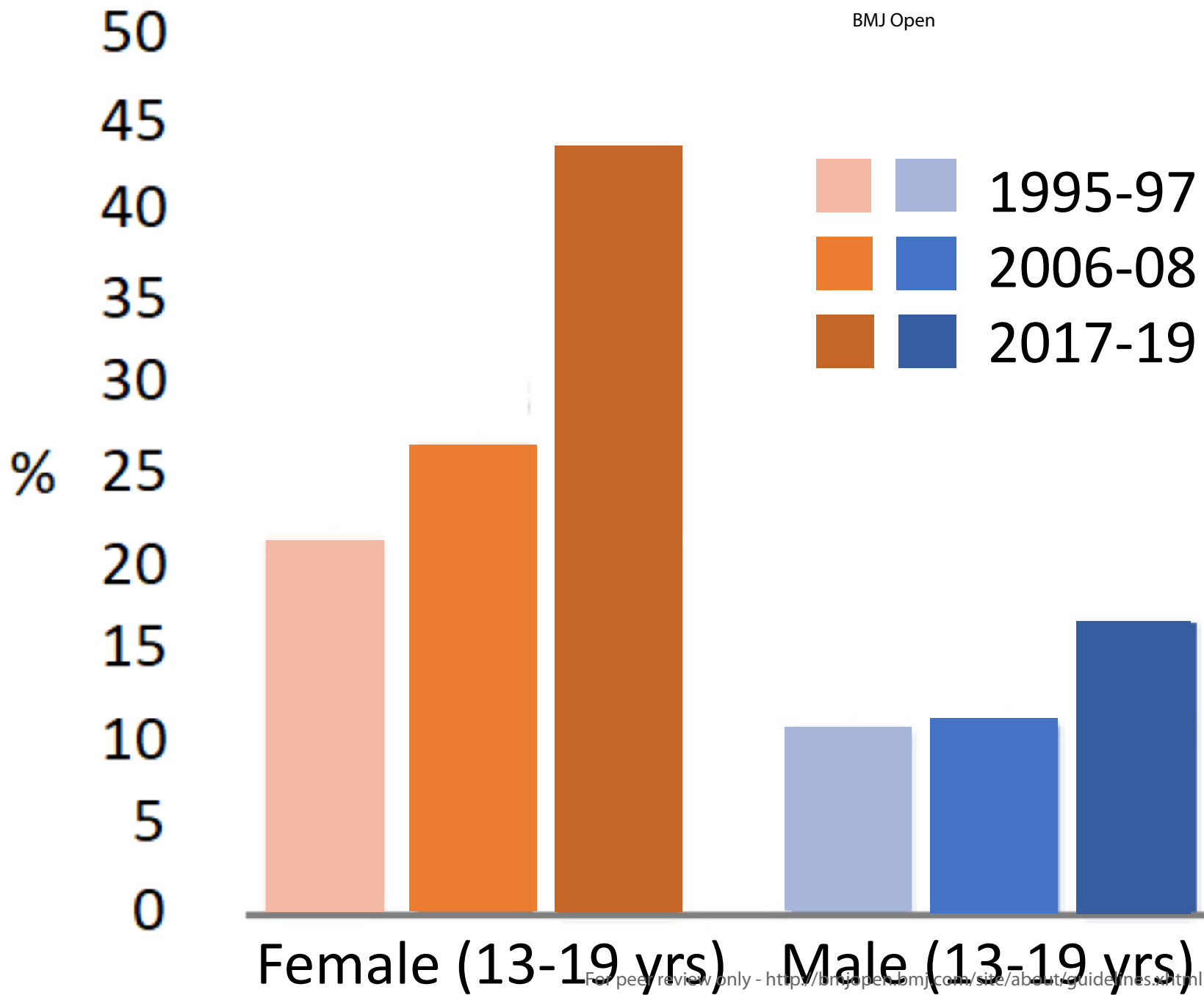
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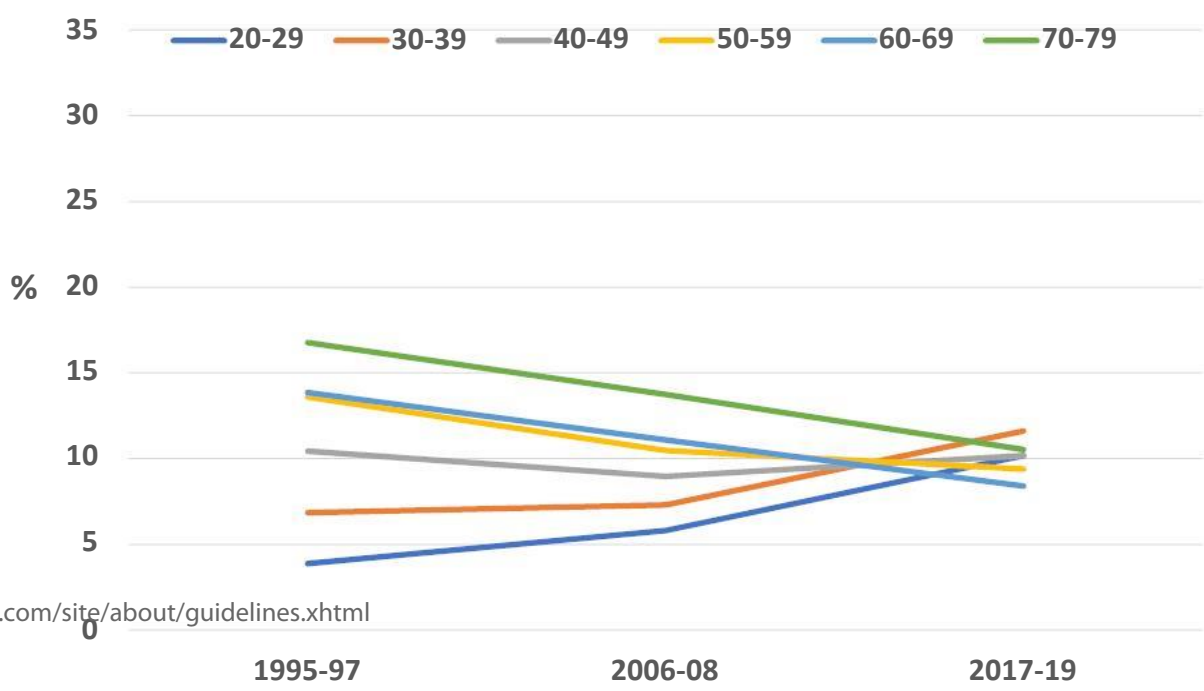
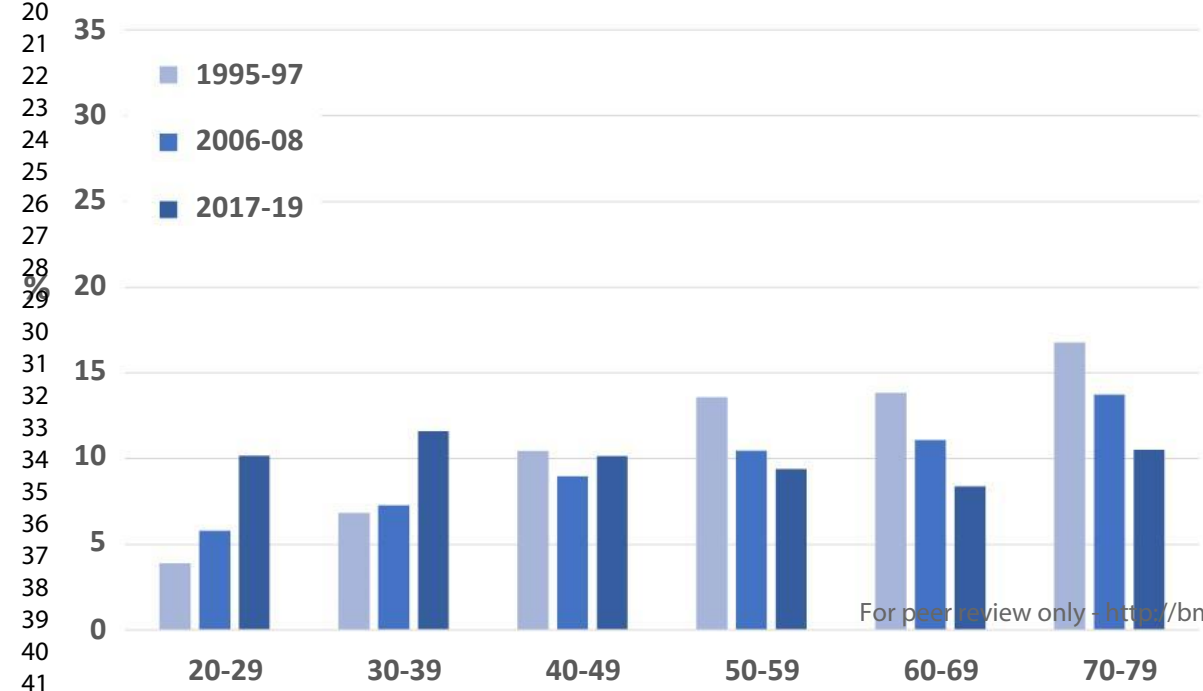
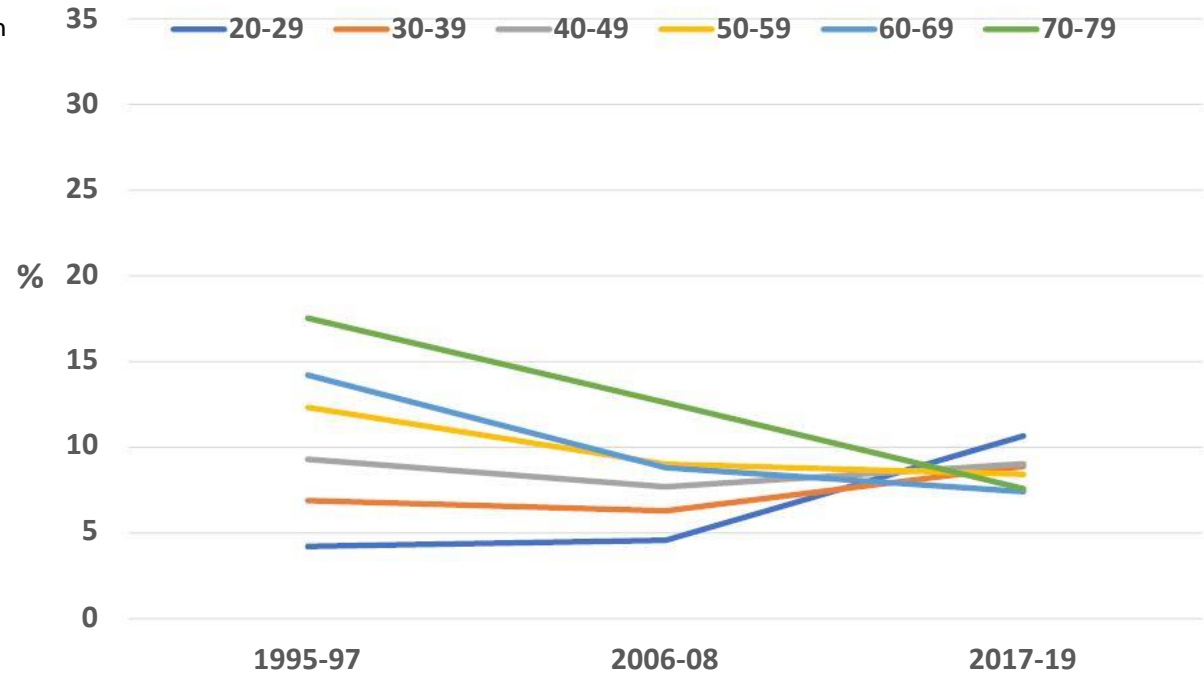
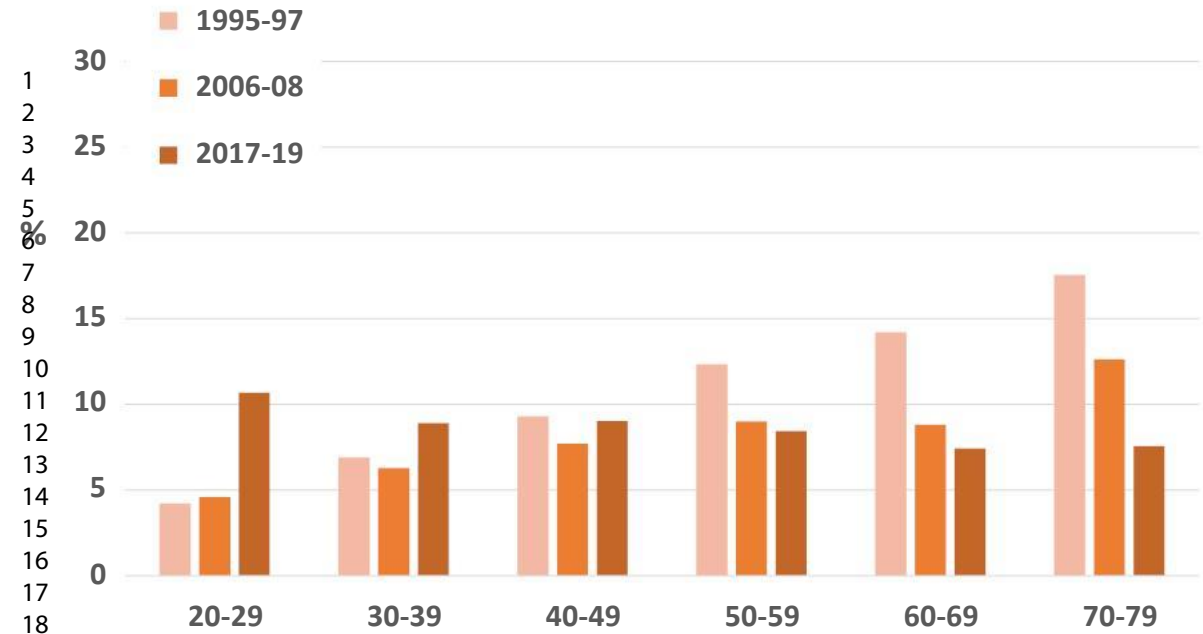


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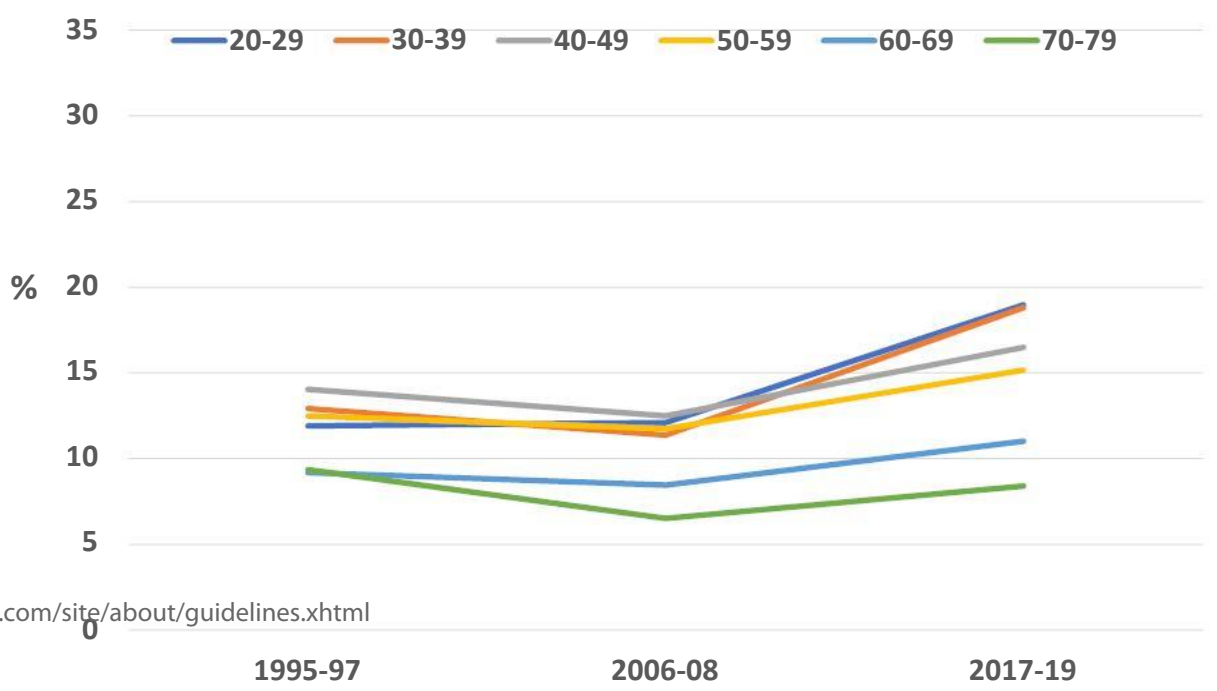
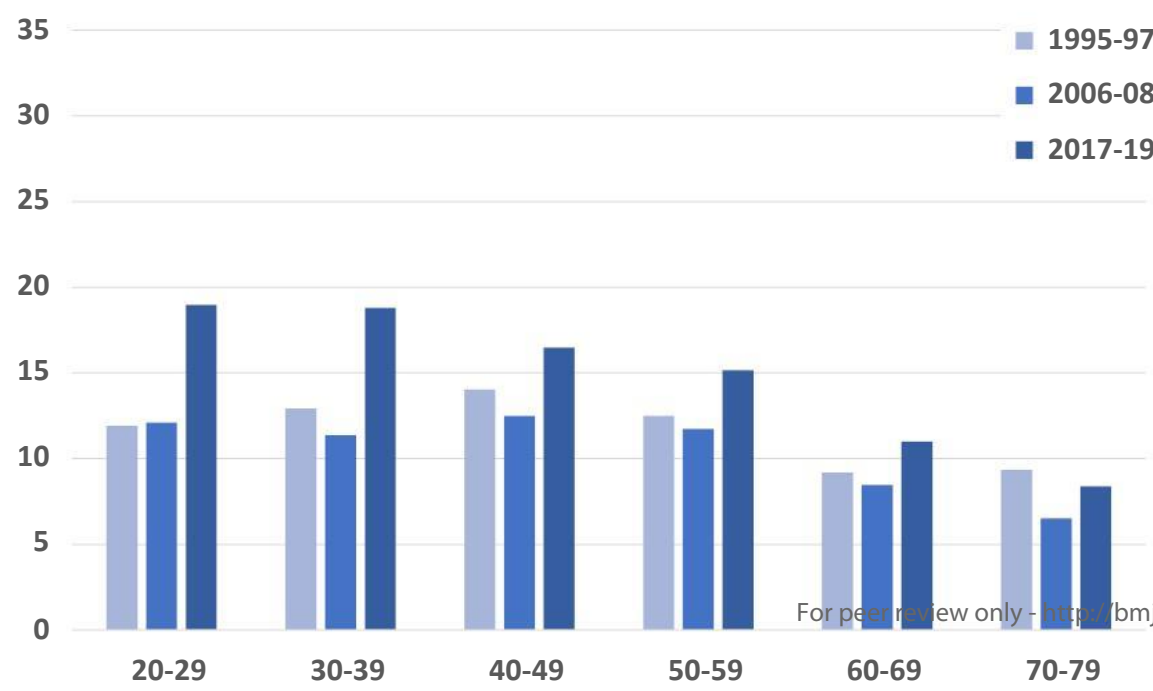
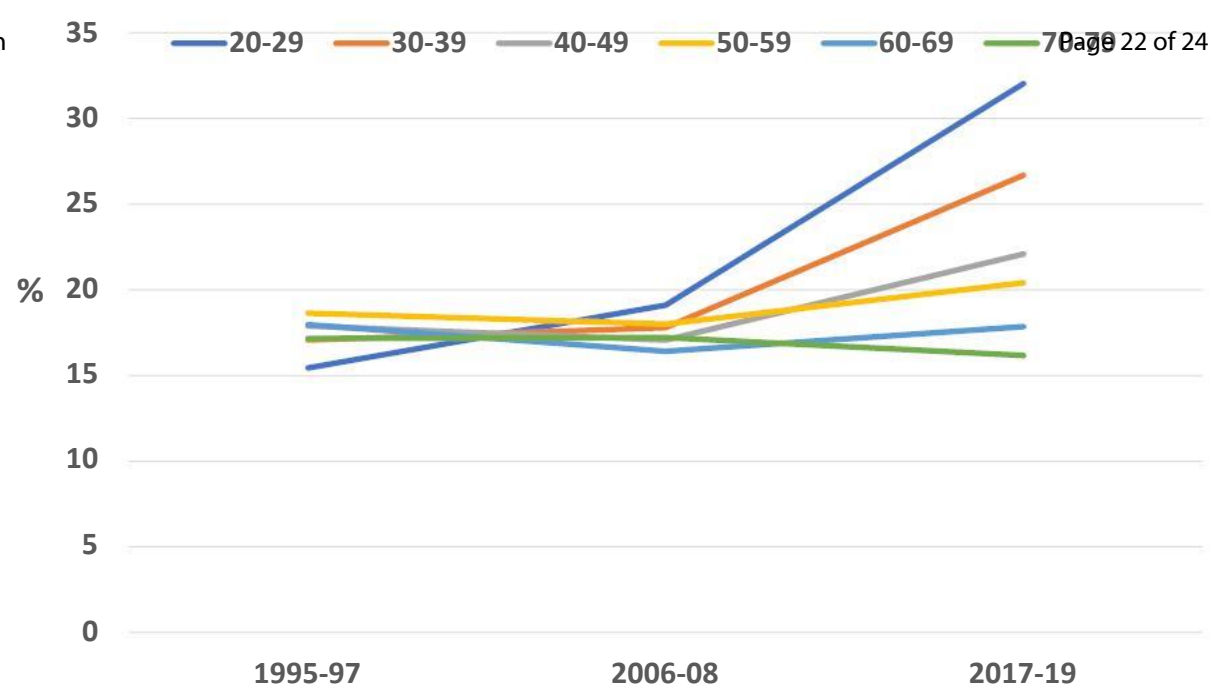
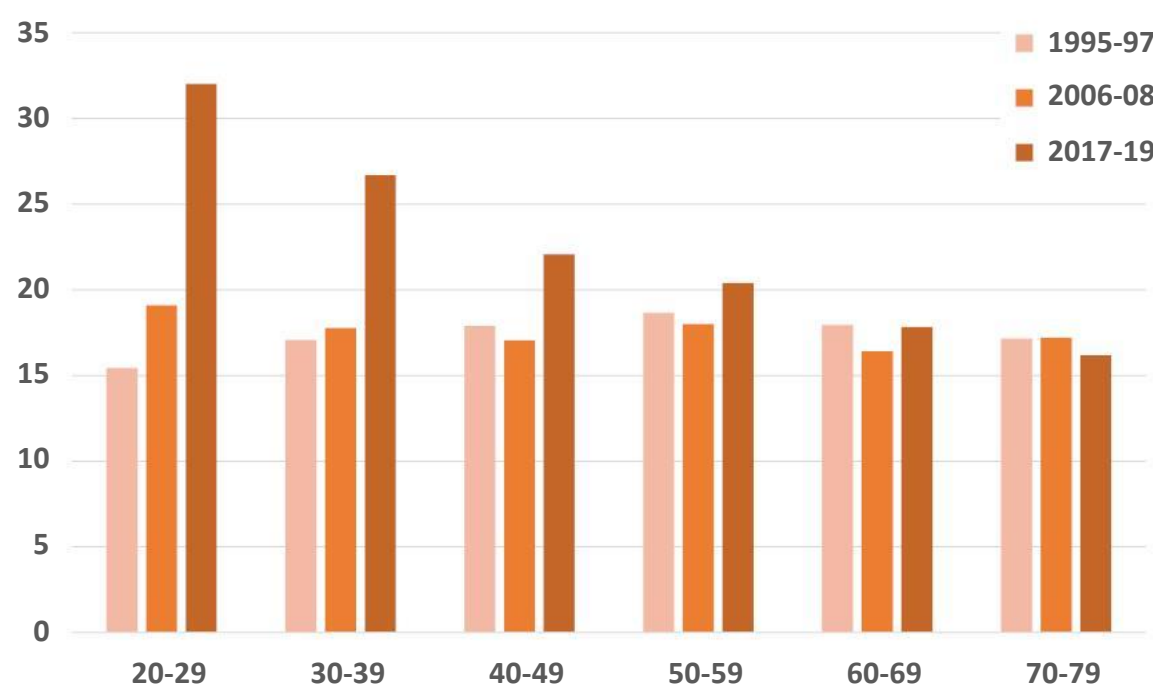


Female (13-19 yrs) Male (13-19 yrs)

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Appendix table 1

Appendix table 1. Prevalence (%) and 95 percent confidence interval (95% CI) for symptoms of poor mental health by age group and sex.

		HUNT2		HUNT3		HUNT4		P-value for trend	
		Prevalence	95% CI	Prevalence	95% CI	Prevalence	95% CI		
HADS depression									
Women	20-29	4.2	(3.7 - 4.8)	4.6	(3.7 - 5.7)	10.7	(9.5 - 12.0)	0.000	
	30-39	6.9	(6.3 - 7.6)	6.3	(5.5 - 7.2)	8.9	(7.9 - 10.1)	0.004	
	40-49	9.3	(8.6 - 10.0)	7.7	(6.9 - 8.5)	9.0	(8.2 - 10.0)	0.377	
	50-59	12.3	(11.5 - 13.3)	9.0	(8.3 - 9.9)	8.4	(7.7 - 9.3)	0.000	
	60-69	14.2	(13.2 - 15.3)	8.8	(8.0 - 9.7)	7.4	(6.7 - 8.2)	0.000	
Men	70-79	17.5	(16.3 - 18.9)	12.6	(11.4 - 14.0)	7.6	(6.8 - 8.5)	0.000	
	20-29	3.9	(3.3 - 4.5)	5.8	(4.5 - 7.4)	10.2	(8.7 - 11.9)	0.000	
	30-39	6.9	(6.2 - 7.6)	7.3	(6.2 - 8.6)	11.6	(10.2 - 13.2)	0.000	
	40-49	10.4	(9.7 - 11.2)	9.0	(8.0 - 10.0)	10.2	(9.0 - 11.4)	0.358	
	50-59	13.6	(12.7 - 14.6)	10.5	(9.6 - 11.4)	9.4	(8.5 - 10.4)	0.000	
HADS anxiety	60-69	13.9	(12.8 - 15.0)	11.1	(10.2 - 12.1)	8.4	(7.6 - 9.3)	0.000	
	70-79	16.8	(15.4 - 18.2)	13.7	(12.4 - 15.2)	10.5	(9.5 - 11.6)	0.000	
	Women	20-29	15.5	(14.4 - 16.5)	19.1	(17.4 - 21.0)	32.0	(30.1 - 33.9)	0.000
		30-39	17.1	(16.1 - 18.1)	17.8	(16.5 - 19.2)	26.7	(25.1 - 28.4)	0.000
		40-49	17.9	(17.0 - 18.9)	17.1	(16.0 - 18.2)	22.1	(20.8 - 23.4)	0.000
50-59		18.6	(17.5 - 19.8)	18.0	(17.0 - 19.1)	20.4	(19.3 - 21.6)	0.028	
60-69		18.0	(16.7 - 19.3)	16.4	(15.4 - 17.6)	17.9	(16.8 - 19.0)	0.896	
Men	70-79	17.2	(15.7 - 18.8)	17.2	(15.8 - 18.8)	16.2	(15.0 - 17.4)	0.290	
	20-29	11.9	(10.9 - 13.0)	12.0	(10.2 - 14.2)	19.0	(17.0 - 21.2)	0.000	
	30-39	12.9	(12.0 - 13.9)	11.4	(10.0 - 12.9)	18.8	(17.0 - 20.7)	0.000	
	40-49	14.0	(13.2 - 15.0)	12.5	(11.4 - 13.7)	16.5	(15.1 - 18.0)	0.030	
	50-59	12.5	(11.6 - 13.5)	11.7	(10.8 - 12.7)	15.2	(14.0 - 16.4)	0.001	
60-69		9.2	(8.3 - 10.2)	8.5	(7.6 - 9.4)	11.0	(10.1 - 12.0)	0.004	
	70-79	9.4	(8.2 - 10.6)	6.5	(5.6 - 7.6)	8.4	(7.5 - 9.4)	0.325	

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

The following recommendations were followed if applicable for the manuscript: Paradoxical trends in mental health in the society and the root causes of increased mental health problems among young people. The HUNT Study, Norway.

	Item No	Recommendation	Page in manus.
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4-5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4-5
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4-5
Bias	9	Describe any efforts to address potential sources of bias	11
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	4
		(b) Describe any methods used to examine subgroups and interactions	4
		(c) Explain how missing data were addressed	5-6
		(d) If applicable, describe analytical methods taking account of sampling strategy	Na
		(e) Describe any sensitivity analyses	Na
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	4
		(b) Give reasons for non-participation at each stage	4
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	5
		(b) Indicate number of participants with missing data for each variable of interest	5

Outcome data	15*	Report numbers of outcome events or summary measures	5
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6-9
		(b) Report category boundaries when continuous variables were categorized	5-9
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Na
Discussion			
Key results	18	Summarise key results with reference to study objectives	9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9-10, 11-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	10
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.