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Public health in restructuring coastal communities: Generational trends in self-rated health following the decline in small-scale fishing. The HUNT study, Norway

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ABSTRACT

Restructuring rural communities can be seen as natural population level experiments of great social epidemiological interest. Following the extensive decline in small-scale fishing in the later decades of the 20th century, many coastal communities have undergone considerable societal restructuring. In Norway, this has entailed a substantial reduction of the fishing workforce, concurrent with new employment opportunities in public sector and aquaculture. The former socialization into fishing from a young age is greatly reduced, with coastal youths now facing other life courses than preceding generations. As restructuring of societies is found to be intertwined with public health, coastal communities can provide valuable insights on public health during times of transitions. In this study, we use repeated cross-sectional population health data from rural Norwegian municipalities to assess the development of self-rated health over four decades in a coastal population who has undergone restructuring of local labour markets. We assess generational differences in health by comparing the prevalence of poor self-rated health at three ages reflecting three generations at each cross section: youths, adults and elderly. We compare results to adjacent geographical areas to assess geographical differences in self-rated health over time. We found a higher predicted prevalence of poor self-rated health in rural coastal adults and elderly compared to other geographical areas across all decades. However, trends revealed improving self-rated health in rural coastal adults and elderly, as well as narrowing health gaps between the rural coastal population and the remaining geographical areas in this Norwegian setting. Our results shed light on public health development in restructuring coastal communities.

1. Introduction

Following the later decades of the 20th century, many North European and North American coastal areas have faced a substantial decline in small-scale fishing (Olson, 2011; Pinkerton and Davis, 2015). Small-scale fishing has been a long-standing industry entangled with both social and economic relations of numerous coastal communities (Johnson et al., 2018; Urquhart et al., 2011), providing employment and survival for coastal inhabitants. Internationally, small-scale fishing is taking place in a wide range of waters, marine ecosystems and political arrangements (Smith and Basurto, 2019), and has traditionally included smaller vessels with low-tech gear, smaller crews and the support of whole households (Johnson et al., 2018). The observed decline in this industry has in many cases been spurred by regulations of fishing quotas and privatization of fisheries (Olson, 2011), resulting in considerable societal restructuring of afflicted areas.

This development is also apparent in Norwegian coastal areas. The Norwegian fishing fleet was previously characterized by open access without quota restrictions (Standal et al., 2016). The later decades of the 20th century entailed several major drops in fish stocks following a long

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period of overfishing, resulting in the introduction of quota regulations (Holm et al., 2015). This resulted in a substantial reduction of the Norwegian fishing fleet, where many workers with small vessels were no longer able to rely on fish supply for their livelihood (Christensen, 2014; Christensen and Zachariassen, 2014). For rural and small coastal communities with an established dependency on small-scale fishing, the downturn had substantial consequences; some Norwegian coastal communities were completely vacated, while others have endured out-migration and restructuring of local labour markets (Vik et al., 2011; Iversen et al., 2020). Fishing is now a livelihood for fewer people; the remaining vessels are fewer and bigger; and there has been an extensive technological development in fishing gear and catching (Sønvisen et al., 2011). Consequently, the inclusion of whole households in fishing-related activities and the socialization of young people into fishing are greatly reduced (Johnsen, 2004; Vik et al., 2011; Jentoft and Wadel, 1984).

Alongside the decline in small-scale fishing employment, Norway has experienced considerable growth in other areas of employment. The post-war era was a time of tremendous investments in the Norwegian public sector, with 80 percent of the national net increase in man-years between 1950 and 1980 taking place in the public service production (Mørk, 1984). The increase in public sector employment opportunities also benefitted rural areas in Norway, as this was a time of an increasingly active policy on upholding settlements in peripheral areas (Brox, 1980). Another emerging industry of the time was aquaculture, which has provided both employment opportunities and economic growth in many coastal communities. The collapses in fish stocks prompted many fishers to re-evaluate the possibilities of coastal resources. Investments in Norwegian fish farming were modest at first, but from the mid-1980s fish farming became a full-time job for many transitioning from the traditional fishing industry (Christensen and Zachariassen, 2014). In 2017, Norway was the second largest exporter of fish and fish products in the world (FAO, 2018). This have provided new opportunities of employment and income in many Norwegian coastal areas (Vik et al., 2011; Sønvisen et al., 2011; Christensen and Zachariassen, 2014).

In sum, Norwegian coastal areas have experienced several societal developments following the mid-20th century. To illustrate the greater trends over time, we present the developments in fishing activities and public sector employment in Norway from 1960 to 2017 below (Fig. 1).[1]

Restructuring of societies are found to be intertwined with public health (Stuckler et al., 2009), and societal conditions, social relations and community are rooted in a historical and cultural context which affects health behaviours and how health is perceived (Stephens, 2008). The transformations of Norwegian coastal communities can be considered natural experiments with potential impacts on the health of inhabitants, therefore being of great research interest. Former findings indicate that rural coastal populations with a history of small-scale fishing had higher odds of reporting poor self-rated health compared to other areas, hereunder both inland and other coastal-adjacent areas, after controlling for several compositional factors (Hjorthen et al., 2020). Still, it should be noted that the literature on health in fishery-based rural areas is scarce. There has been a growing interest in coastal health, with studies examining health effects of both biological aspects of marine life (Stewart et al., 2008), and social and emotional aspects of coastal living (Wheeler et al., 2012; White et al., 2013; Garrett et al., 2019; Pasanen et al., 2019), but the majority of existing research on coastal health does not target coastal communities with a history of small-scale fishing. Consequently, our knowledge about public health in coastal areas afflicted by a declining fishing industry and transitions to new industries is limited.

Economic and social changes operating over decades are found to be of larger importance for health than short-term policy interventions (Hanlon and McCartney, 2008). Therefore, potential changes in health during times of a decline in an important industry such as small-scale fishing should not be underplayed. Two main aspects of the Norwegian coastal restructuring are interesting in a health perspective. Firstly, the decline in small-scale fishing also entails a decline in dangerous working conditions for many coastal inhabitants. Small-scale fishing has historically been characterized by risk and hardship (Koren, 2017), with long hours, risk of injuries and vulnerability to weather conditions and stock fluctuations (Matheson et al., 2001; Petursdottir et al., 2001). Additionally, the lifestyle among fishers has been associated with both higher levels of smoking and alcohol intake (Koren, 2017; Thorvaldsen et al., 2016). Currently, fishing is a considerably less prevalent occupation, and coastal youth largely encounter formal schooling instead of primary socialization into local fishing crews (Vik et al., 2011).

Secondly, the detrimental decline in small-scale fishing has been followed by new and stable employment opportunities in both public sector and aquaculture. The decline in small-scale fishing undoubtably resulted in an extensive reduction in coastal-based livelihoods, potentially leaving people unemployed. The correlation between unemployment and poor health has been widely studied and confirmed (Abebe et al., 2016; Tøge and Blekesaune, 2015), also in countries with long-standing welfare services (Bambra and Eikemo, 2008). Unemployment has been found to negatively affect well-being, possibly resulting in poor physical health over time (Bartley et al., 2006; Korpi, 2001; Ytterdahl and Fugelli, 2000), in addition to long-term consequences for the displaced workers, with earning losses and worsened labour-market position exceeding the transitory period of adjustment (Eliason and Storrie, 2006). The concurrent rise in public sector employment opportunities, and later in aquaculture, could possibly buffer potential drops in public health during times of unemployment and economic recession.

The great shift from small-scale fishing to alternative employment opportunities and economic growth has likely gradually improved the general working conditions for many inhabitants in rural coastal areas. There is reason to believe that people growing up in rural coastal communities today face somewhat other life courses and employment opportunities than their preceding generations of parents and grandparents. On the same note, compared to previous generations, the current working age coastal population probably faces different working conditions, and the current elderly coastal population probably holds different working experiences. Although economic growth does not guarantee a progress in health (Tapia Granados and Ionides, 2008), the importance of life chances and employment opportunities for health have been thoroughly documented (McDade et al., 2011; Harris et al., 2002), which gives reason to anticipate an enhancement of public health in the surviving and restructured fishing- and coastal-involved areas. Compared to other geographical areas that have not experienced an equally sizeable decline in a local industry, one might anticipate differing trends in health over the same period, with a potentially eventual narrowing in favour of coastal areas as labour markets likely have become more similar across regions over time.

In this study, using repeated cross-sectional population health data from Norwegian municipalities, we assess the development of self-rated health over four decades in rural coastal areas with a history of small-scale fishing. In this examination of a coastal population who has faced both decline and development in local labour markets, we aim to assess generational differences in health by comparing the prevalence of poor self-rated health at three ages reflecting three generations at each cross section; youths, adults and elderly. This is an observational study aiming at describing generational trends in self-rated health during times of societal restructuring. Our analyses do not aim to demonstrate causality between societal restructuring and changes in health situation. Based on earlier findings and methods indicating poorer health in rural coastal areas compared to both inland and other coastal-adjacent areas (Hjorthen et al., 2020), we will compare results between rural coastal, urban coastal, inland and fjord areas to assess whether geographical

[1] Numbers derived from SSB (Statistics Norway) table 07811, 07842, 03214, 07326 and 09174, and NSD (Norwegian centre for research data).

Fig. 1. Developments in registered fishers, vessels, farmed fish sold (tons), employment in aquaculture (persons) and public sector (public administration, education and health services) (portion of total employment). 1960–2017. Norway. All trends are presented together for illustrational purposes. Axes are not fixed or comparable.

differences in self-rated health are stable over time. With this study we aim to provide insights to health developments in rural coastal communities following the extensive international decline in small-scale fishing.

2. Methods

2.1. Data

Our study was based on data from the Trøndelag Health Study (HUNT), a Norwegian adult population-based cross-sectional health survey conducted four times in the now former county of Nord-Trøndelag: 1984–86 (HUNT1), 1995–97 (HUNT2), 2006–08 (HUNT3) and 2017–19 (HUNT4) (Krokstad et al., 2013). All county inhabitants of 20 years and older were invited to participate. The total participation in the four surveys was 89 %, 70 %, 54 % and 54 % of the invited population, respectively. The education and income level of the Nord-Trøndelag county were somewhat lower than the national Norwegian average, but the area was still considered representative of the overall Norwegian population (Krokstad et al., 2004). Because of missing data on self-rated health and municipality, we excluded 340 observations (0.4 %) from HUNT1, 525 (0.8 %) from HUNT2, 2219 (4.4 %) from HUNT3 and 2313 (4.1 %) from HUNT4. The final sample sizes were 76860 (HUNT1), 64703 (HUNT2), 48583 (HUNT3), and 53763 (HUNT4).

2.2. Geographical categorisation: rural coast, urban coast, rural inland and rural fjord

The Nord-Trøndelag county consisted of 24 municipalities, and in line with former findings (Hjorthen et al., 2020), these were classified into four geographical categories: rural coast, urban coast, rural inland and rural fjord. Characteristics of coastline and employment in fishing and aquaculture are found in Table 1. These numbers are collected from Statistics Norway, the Norwegian Centre for Research Data's (NSD) municipality database and the Norwegian Directorate of Fisheries. NSD and the Directorate of Fisheries are not responsible for analyses or interpretations in this study. The primary interest of this study is rural coastal areas with a history of small-scale fishing, and five municipalities fall under this category. These municipalities share three coastal characteristics: Firstly, they share a historically substantial proportion of employment in fishing. In 1960, before the major drops in fish stocks, these five municipalities had a considerable proportion of inhabitants with their main occupation in fishing, ranging from 10 to 27 percent, with a total at 17 percent for the area as a whole (NSD). The Nord-Trøndelag county has been an area characterized by small vessels and few fisheries employees (Hovland, 2014), and has close to no local employment in oil exploitation. Secondly, these municipalities have posed as long-standing coastal trading points (Herje, 1999), as they border to the big ocean instead of to the county fjord, and are therefore located by historical coastal shipping routes. Thirdly, the five municipalities have a low land-to-coast ratio, with a total area average of 0.46 km^2 land per km of coastline. This implies greater physical proximity to the coast for the inhabitants of these municipalities compared to other areas or municipalities of the county.

Five municipalities were classified as urban coastal areas. These municipalities are historical town areas. All urban coastal municipalities border to the coast, four of them in fjord areas, with an area total land-to-coast ratio of 6.39 km^2 land per km of coastline. The remaining rural municipalities were divided into two categories: rural fjord and rural inland. Both categories have no pronounced history of fishing (1.6 and < 1 percentage of the total workforce in 1960, respectively). Still, the fjord and inland categories differ significantly in land-to-coast ratio (4.88 km^2 and close to no coastline, respectively). Considering that former studies have revealed possible health effects of coastal proximity (Wheeler et al., 2012; White et al., 2013; Garrett et al., 2019; Pasanen et al., 2019), our study validity most likely benefits from differentiating between these areas.

The former county of Nord-Trøndelag has, as the total Norwegian nation, experienced a substantial decline in registered fishers and vessels, while experiencing a growth in aquaculture employment. The rural coastal areas, the region of interest in this study, have historically had a higher level of unemployment compared to the national level. After the millennium, this has changed. These changes are illustrated in Fig. 2.[2]

2.3. Measurement of health

The outcome of this study was self-rated general health. Self-rated health is a validated and widely used measurement of health; it has been shown to have strong predictive ability on mortality, morbidity and work-related disability (DeSalvo, 2006; Fosse and Haas, 2009; Schou et al., 2006). The original variable for self-rated health was for all surveys of The HUNT Study measured by the question "How is your health at the moment?" with four response alternatives: "Poor", "Not so good", "Good" and "Very good". All four surveys exhibited skewed distributions of this variable, with few respondents reporting "poor"

[2] Numbers derived from SSB (Statistics Norway) table 1603, 3214, 7811, 7842 and 11618 and NSD (Norwegian centre for research data).

Table 1
Coastline and coastal employment of the geographical categories. Former Nord-Trøndelag County, Norway.

	Km[b] land per km coastline (total)	Percentage of total employment in fishing (main occupation) 1960	Percentage of total employment in fishing (main occupation) 2017 HUNT4[a]	Employment in aquaculture[b] 2017 HUNT4 (County total)
Rural coast	0.46	17.2	2.8	519
Urban (coast)	6.39	<1	<0.1	
Rural inland	506.51	<1	<0.1	
Rural fjord	4.62	1.6	<0.1	

[a] Numbers based on register of Norwegian fishermen (main occupation), Norwegian Directorate of Fisheries.
[b] Employment in aquaculture not available om municipality level (see Fig. 1).

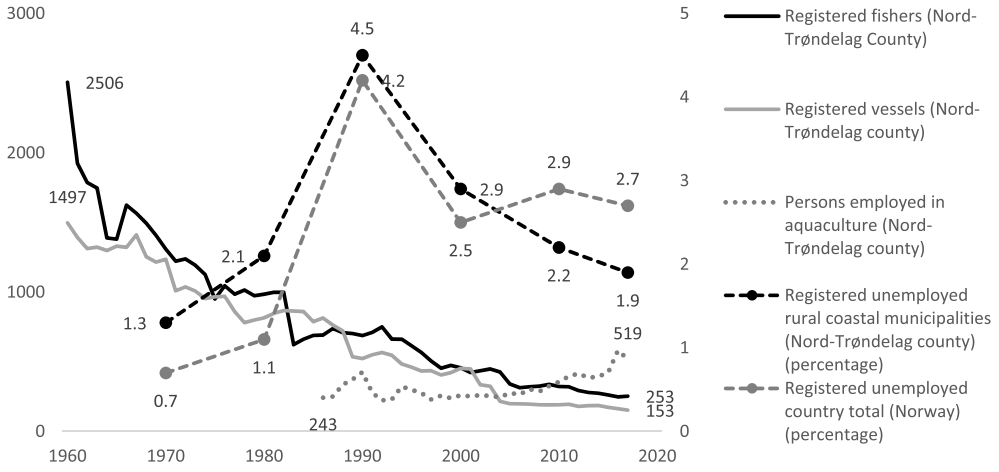

Fig. 2. Number of registered fishers, vessels and employees in aquaculture in the former Nord-Trøndelag County. Registered unemployment level in rural coastal areas compared to nation total, Norway. 1960–2017.

health. The variables were dichotomized, where the responses "Poor" and "Not so good" were merged into "Poor self-rated health", whereas the responses "Good" and "Very good" were merged into "Good self-rated health", functioning as the reference group.

2.4. Statistical analysis

For each HUNT cross-section, we fitted a Poisson regression model with robust variance estimates with poor self-rated health as the dependent variable and gender, age at participation (continuous) and geographical affiliation (rural coast set as reference) as predictors. The robust Poisson regression is recognised as an adequate method for handling binary outcomes, especially when the prevalence of the outcome is low and the model contains continuous covariates (Huang, 2019). Considering potential differing health trends between gender, generation and geographical affiliation between geographical categories, we estimated a three-way full-factorial regression model, allowing for interactions between all covariates. We tested each model with quadratic interactions of age, where Wald tests revealed statistically significant quadratic functions of age in all four models. Calculations showed that the vertex of the parabola lied outside the range of relevant values of age in all models. This means that the turning point of the curvilinear relationship between health and age does not lie within the relevant range of age (20–70 years).

From our regression models we estimated predicted prevalences of poor self-rated health at three ages (20, 45 and 70) for each geographical category. This method is known as adjusted predictions at representative values (APRs) (Williams, 2012) and for ease of communication we refer to them just as prevalences in the following. The ages 20, 45 and 70 years were chosen to reflect both generational divides in health and observed health at three different stages of life: young adulthood, working age and retired from the workforce. In addition, marginal effects (at representative values – MERs) of geographical affiliation were calculated at each age. Marginal effects provide an approximation to the amount of change in the outcome probability that will be produced by a one-unit change in an independent variable. In our study, the calculated marginal effects are the difference in the adjusted predictions for each geographical category (rural coast as reference), given the specific values of age. We also calculated marginal effects of gender contrasted between geographical categories (rural coast as reference) to test for statistically significant differences in effects of gender between the geographical categories. Both adjusted predictions at representative values and marginal effects at representative values were calculated using the margins postestimation command in Stata version 16. Changes in percent of prevalence and marginal effects of geographical affiliation from HUNT1 to HUNT4 is provided, and can be interpreted as how much of the gaps between the geographical categories and rural coast

Table 2
Change in inhabitants and registered employees* in total population from HUNT1 to HUNT4. Former Nord-Trøndelag County, Norway.

	HUNT1 1984–86	HUNT4 2017–19	Change
Rural coast			
Inhabitants	12927	11858	−8%
Registered employees	3456	5414	+57 %
Urban coast			
Inhabitants	78616	93389	+19 %
Registered employees	29881	43484	+46 %
Rural inland			
Inhabitants	17001	14968	−12 %
Registered employees	5565	6648	+19 %
Rural fjord			
Inhabitants	18167	17018	−6%
Registered employees	5780	7281	+26 %

*Statistics are derived from NSD and Statistics Norway, and do not include self-employment.

Table 3
Characteristics of the study population and prevalence of poor self-rated health in geographical areas. The HUNT Study 1–4.

	HUNT1	HUNT2	HUNT3	HUNT4
	1984–86	1995–97	2006–08	2017–19
Rural coast				
N	7981	6144	4230	4876
Mean age	51	51	54	54
Men (%)	49	47	45	46
Poor self-rated health (%)	36	35	34	30
Urban coast				
N	46378	40819	31282	35112
Mean age	49	49	53	54
Men (%)	48	47	46	45
Poor self-rated health (%)	25	26	24	23
Rural inland				
N	11142	8555	6421	6814
Mean age	50	52	54	56
Men (%)	51	48	47	47
Poor self-rated health (%)	25	27	26	25
Rural fjord				
N	11359	9185	6650	6961
Mean age	51	52	54	56
Men (%)	49	48	46	47
Poor self-rated health (%)	31	31	29	26
Total				
N	76860	64703	48583	53763
Mean age	49	50	53	55
Men (%)	49	47	46	45
Poor self-rated health (%)	27	28	26	24

(reference category) have changed.

3. Results

Table 2 shows the change in inhabitants and employment in the total population for all geographical categories from HUNT1 to HUNT4. Rural coastal areas have experienced the biggest increase (57 %) in registered employees of the geographical categories. Rural inland exhibits the largest decline (12 %) in inhabitants. Population statistics show that the total size of the working-age population in rural coastal areas has remained stable from the time of HUNT1 to HUNT4 (SSB, 2021a), indicating that a greater portion of the population is now employed compared to earlier. Table 3 shows general characteristics of the study populations in all surveys of the HUNT Study. There was no apparent skewness in age and gender between the geographical categories. The prevalence of poor self-rated health was highest in rural coastal areas in all surveys of the HUNT Study and overall lowest in the urban coastal areas.

Table 4 shows adjusted predictions of poor self-rated health for three generations from HUNT1 to HUNT4 for all geographical categories. Figs. 3 and 4 illustrate the development in prevalence and marginal effects of geographical affiliation, presented for each generation.

Youths in rural coast areas had the highest prevalence of poor self-rated health of the four geographical areas at HUNT1. Youths in urban coast had the highest prevalence of poor self-rated health at HUNT2, and rural fjord youths at HUNT3 and HUNT4 (Table 4, Fig. 3A). Youths of all geographical areas showed a substantial increase in poor self-rated

Table 4
Adjusted predictions of prevalence of poor self-rated health in three generations. 95 % confidence interval in parentheses. Marginal effects express the difference in the adjusted predictions between each geographical category and rural coast at the specified age value. Gender is an additional marginal effect contrasted between each geographical category and rural coast, significant differences in gender effects are assessed through confidence intervals. Total change expresses change from HUNT1 to HUNT4. Total change for marginal effects should be interpreted as either an increase or reduction of gaps between each geographical category and rural coast depending on the prefix."

	HUNT1	HUNT2	HUNT3	HUNT4	Total change
	1984–86	1995–97	2006–08	2017–19	
Rural coast					
Youths (20)	**5.2 (4.4, 6.1)**	**6.3 (5.1, 7.5)**	**7.9 (5.7, 10.0)**	**12.1 (9.8, 14.5)**	+133 %
Adults (45)	**27.3 (26.1, 28.6)**	**27.4 (26.1, 28.8)**	**24.0 (22.4, 25.6)**	**22.2 (20.8, 23.6)**	−19 %
Elderly (70)	**63.1 (61.2, 64.9)**	**57.6 (55.5, 59.7)**	**49.3 (47.0, 51.6)**	**39.7 (37.8, 41.7)**	−37 %
Urban (coast)					
Youths (20)	**4.5 (4.1, 4.8)**	**6.8 (6.3, 7.4)**	**8.1 (7.3, 9.0)**	**11.9 (11.0, 12.8)**	+164 %
Marginal effect	*−0.7 (-1.7, 0.2)*	*0.5 (-0.8, 1.9)*	*0.3 (-2.0, 2.6)*	*−0.2 (-2.7, 2.3)*	*(−)71 %*
Gender	*−1.2 (-3.0, 0.7)*	*−0.9 (-3.6, 1.8)*	*1.5 (-2.9, 6.0)*	*−0.3 (-5.3, 4.7)*	
Adults (45)	**19.7 (19.2, 20.1)**	**20.7 (20.2, 21.2)**	**18.8 (18.3, 19.4)**	**17.5 (17.0, 17.9)**	−11 %
Marginal effect	***−7.7 (-9.0, -6.4)***	***−6.7 (-8.2, -5.3)***	***−5.2 (-6.9, -3.5)***	***−4.8 (-6.3, -3.3)***	*(−)38 %*
Gender	*−0.6 (-3.2, 2.0)*	*0.8 (-2.0, 3.7)*	*0.8 (-2.6, 4.1)*	*0.0 (-2.9, 3.0)*	
Elderly (70)	**45.8 (45.0, 46.6)**	**42.9 (42.1, 43.7)**	**35.7 (34.9, 36.5)**	**29.7 (29.1, 30.4)**	−35 %
Marginal effect	***−17.3 (-19.3, -15.3)***	***−14.7 (-16.9, -12.4)***	***−13.6 (-16.0, -11.1)***	***−10.0 (-12.1, -8.0)***	*(−)42 %*
Gender	*−0.9 (-4.9, 3.1)*	*−1.3 (-5.8, 3.2)*	*0.7 (-4.3, 5.6)*	*−0.8 (-4.9, 3.3)*	
Rural inland					
Youths (20)	**4.1 (3.4, 4.8)**	**6.0 (4.9, 7.1)**	**5.7 (4.2, 7.2)**	**9.7 (7.8, 11.6)**	+137 %
Marginal effect	*−1.1 (-2.2, 0.0)*	*−0.3 (-2.0, 1.4)*	*−2.2 (-4.8, 0.5)*	*−2.5 (-5.5, 0.5)*	*(+)127 %*
Gender	*−1.9 (-4.1, 0.3)*	*0.9 (-2.5, 4.2)*	*2.0 (-3.1, 7.1)*	*−1.3 (-7.3, 4.6)*	
Adults (45)	**18.4 (17.5, 19.3)**	**20.7 (19.6, 21.8)**	**19.0 (17.7, 20.2)**	**16.6 (15.5, 17.6)**	−10 %
Marginal effect	***−9.0 (-10.5, -7.5)***	***−6.7 (-8.5, -5.0)***	***−5.1 (-7.1, -3.1)***	***−5.7 (-7.4, -3.9)***	*(−)37 %*
Gender	*−0.1 (-3.2, 2.9)*	*2.4 (-1.0, 5.8)*	*3.2 (-0.8, 7.2)*	*−0.1 (-3.6, 3.4)*	
Elderly (70)	**42.6 (41.1, 44.1)**	**42.3 (40.6, 44.0)**	**38.7 (36.9, 40.6)**	**31.8 (30.3, 33.4)**	−25 %
Marginal effect	***−20.5 (-22.8, -18.1)***	***−15.3 (-18.0, -12.6)***	***−10.5 (-13.5, -7.6)***	***−7.9 (-10.4, -5.4)***	*(−)61 %*
Gender	*1.8 (-2.9, 6.5)*	*−0.2 (-5.6, 5.2)*	*3.9 (-2.1, 9.8)*	*−0.7 (-5.6, 4.3)*	
Rural fjord					
Youths (20)	**4.8 (4.0, 5.5)**	**6.0 (4.9, 7.1)**	**9.5 (7.5, 11.6)**	**13.1 (10.7, 15.4)**	+173 %
Marginal effect	*−0.5 (-1.6, 0.7)*	*−0.3 (-1.9, 1.3)*	*1.6 (-1.3, 4.6)*	*0.9 (-2.4, 4.2)*	*(+)80 %*
Gender	*−0.6 (-2.8, 1.6)*	*−1.6 (-4.9, 1.6)*	*0.5 (-5.2, 6.3)*	*−2.3 (-8.8, 4.3)*	
Adults (45)	**22.3 (21.3, 23.2)**	**23.8 (22.7, 24.8)**	**21.5 (20.3, 22.8)**	**18.8 (17.7, 19.9)**	−16 %
Marginal effect	***−5.1 (-6.6, -3.5)***	***−3.7 (-5.4, -1.9)***	***−2.5 (-4.5, -0.5)***	***−3.4 (-5.2, -1.6)***	*(−)33 %*
Gender	*0.7 (-2.4, 3.8)*	*0.6 (-2.7, 4.1)*	*3.5 (-0.5, 7.5)*	*−1.8 (-5.4, 1.8)*	
Elderly (70)	**51.8 (50.3, 53.4)**	**49.9 (48.2, 51.6)**	**41.0 (39.2, 42.8)**	**32.3 (30.8, 33.8)**	−38 %
Marginal effect	***−11.3 (-13.6, -8.9)***	***−7.6 (-10.3, -5.0)***	***−8.3 (-11.2, -5.4)***	***−7.5 (-9.9, -5.0)***	*(−)34 %*
Gender	*1.3 (-3.5, 6.1)*	*1.1 (-4.3, 6.5)*	*4.9 (-0.9, 10.8)*	*−0.6 (-5.5, 4.3)*	

Values in bold have 95 % confidence intervals not including the value of 0.

health from HUNT1 to HUNT4, with the biggest change in rural fjord (+173 %), followed by urban coast (+164 %), rural inland (+137 %) and finally rural coast (+133 %). Marginal effects of geographical affiliation showed no statistically significant effects of geographical affiliation (rural coast set as reference) on poor self-rated health in youths across all decades, as all confidence intervals included the value of 0 (Table 4). The negative marginal effects of geographical affiliation, although not significant, increased considerably from HUNT1 to HUNT4 for both rural inland (+127 %) and rural fjord (+80 %), and decreased for urban coast (−71 %). This is shown as narrowing and increasing gaps between rural coast and the other geographical categories in Fig. 4A.

For adults, the rural coast areas had the highest prevalence of poor self-rated health of the four geographical areas for all surveys of the HUNT Study (Table 4, Fig. 3B). Adults of all geographical areas showed a decrease in poor self-rated health from HUNT1 to HUNT4, with the biggest change in rural coast (−19 %), followed by rural fjord (−16 %), urban coast (−11 %) and rural inland (−10 %). Marginal effects of geographical affiliation showed statistically significant negative effects of all geographical categories (rural coast set as reference) on poor self-rated health across all decades. Marginal effects of geographical affiliation laid between −7.7 and −4.8 for urban coast, −9 and −5.1 for rural inland and −5.1 and −2.5 for rural fjord (Table 4). In general, the negative marginal effects of geographical affiliation declined notably from HUNT1 to HUNT4 for all geographical categories: urban coast with −38 %, rural inland with −37 %, and rural fjord with −33 %. This is shown as narrowing gaps between rural coast and the other geographical categories in Fig. 4B.

For elderly respondents, the rural coast areas also here exhibited the highest prevalence of poor self-rated health of the four geographical areas for all surveys of the HUNT Study (Table 4, Fig. 3C). Elderly of all geographical areas showed a substantial decrease in poor self-rated health from HUNT1 to HUNT4, with the biggest change in rural fjord (−38 %), followed by rural coast (−37 %), urban coast (−35 %) and rural inland (−25 %). Marginal effects of geographical affiliation showed statistically significant negative effects of all geographical categories (rural coast set as reference) on poor self-rated health across all decades. Marginal effects of geographical affiliation laid between −17.3 and −10 for urban coast, −20.5 and −7.9 for rural inland and −11.3 and −7.5 for rural fjord (Table 4). Overall, the negative marginal effects of geographical affiliation for elderly declined notably from HUNT1 to HUNT4 for all geographical categories: urban coast with −42 %, rural inland with −61 %, and rural fjord with −34 %. This is shown as narrowing gaps between rural coast and the other geographical categories in Fig. 4C.

At all three ages, marginal effects for gender showed no statistically significant differences in gender effects between geographical categories on poor self-rated health, as all confidence intervals included the value of 0.

4. Discussion

In this study, using self-rated health perception as a measure of health, we aimed to examine and compare the development of health in youths, adults and elderly over four decades between four geographical areas, with emphasis on rural coastal areas with a history of small-scale fishing and recent restructuring of local labour markets. Across all four HUNT surveys, we found a higher prevalence of poor self-rated health in the rural coastal population compared to urban coast, rural inland and rural fjord populations, and a statistically significant higher prevalence of poor self-rated health in the rural coastal population in adults and elderly. Our results provide additional insights to former findings indicating a poorer health situation in rural coastal areas with a history of small-scale fishing compared to other areas (Hjorthen et al., 2020), by showing that these geographical differences persist over time.

The prevalence of poor self-rated health in rural coastal adults and elderly has decreased over the last four decades, whereas the prevalence has substantially increased in rural coastal youths. These trends are also apparent in the remaining geographical categories, thus the overall trends of self-rated health in rural coastal areas seem to be in line with the general development in the total study population of the county. However, it should be noted that the rural coastal population exhibits the smallest increase in poor self-rated health in youths and the largest decrease in adults of the four geographical categories over time. Additionally, as anticipated, decreasing marginal effects indicate narrowing

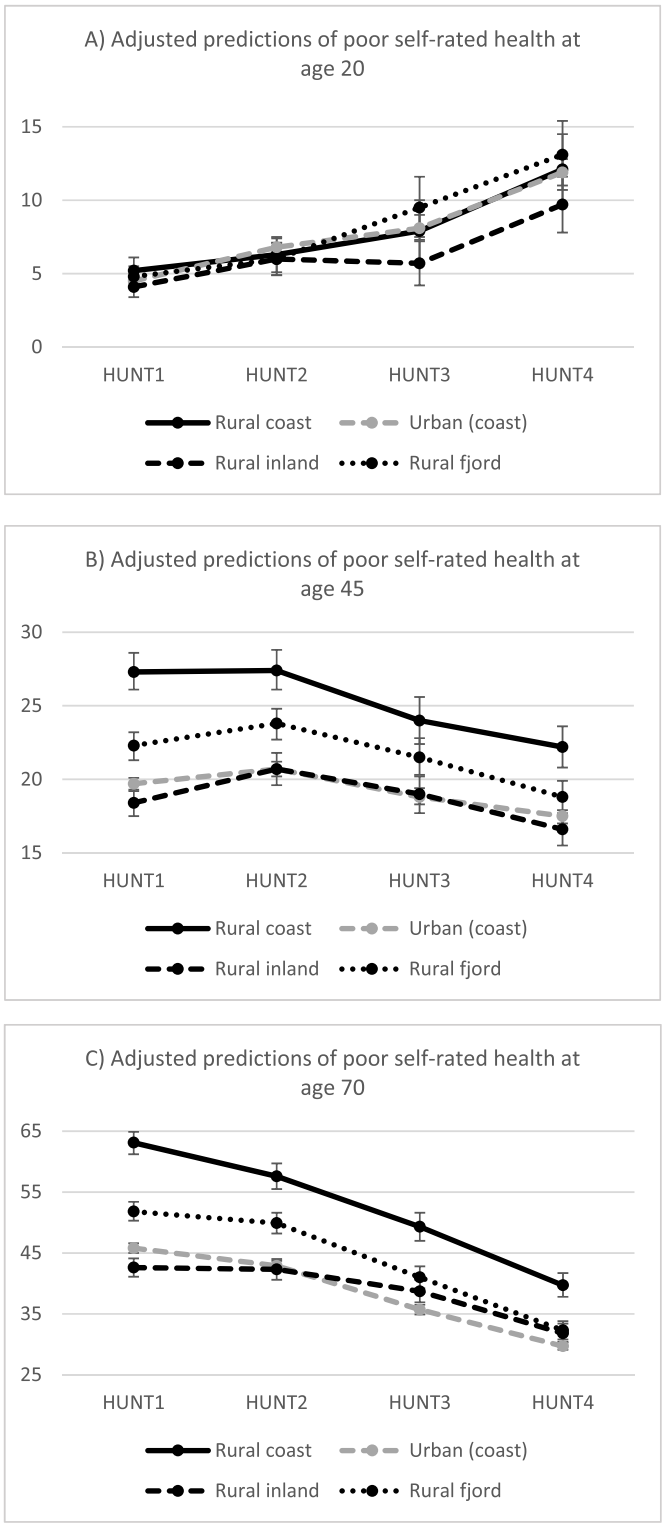

Fig. 3. Prevalence of poor self-rated health at age 20 (A), 45 (B) and 70 (C).

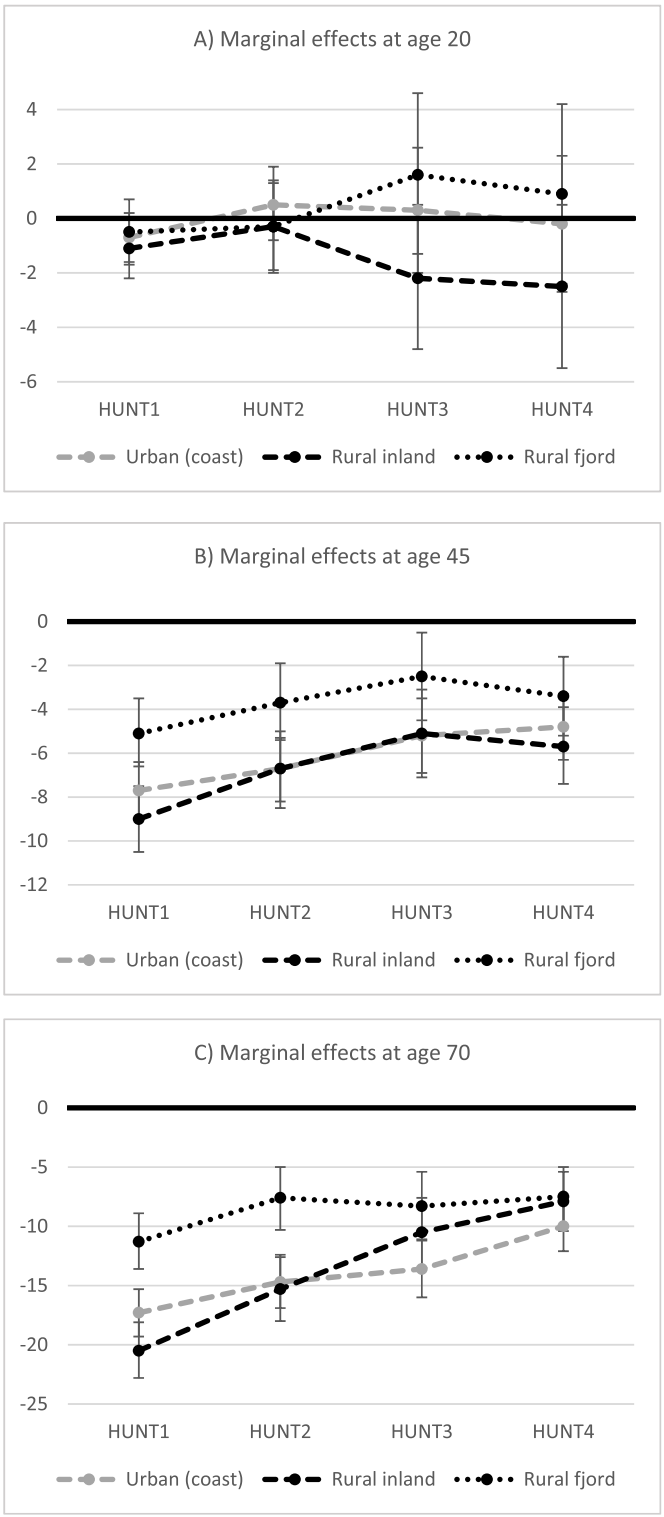

Fig. 4. Marginal effects of geographical affiliation on poor self-rated health at age 20 (A), 45 (B) and 70 (C). This shows the difference in the adjusted predictions for each geographical category. Rural coast set as reference.

gaps in self-rated health between the rural coastal population and the adjacent geographical areas in adults and elderly in this Norwegian setting.

The considerable increase in poor self-rated health in youths of all geographical categories reflects former findings indicating a wider trend of worsening of youth health and well-being, both in Norway, UK, and the United States (Bakken, 2019; Shah et al., 2019; Twenge et al., 2019). We found no statistically significant differences between the rural coastal population and the remaining geographical categories in youths across all four surveys of the HUNT Study. This lack of differences in youth health across geographical areas could be seen in light of the increasing and omnipresent impact of global discourses, independent of variations in rural coastal communities, producing particular images of successful modern self-hood and youth lifestyle. Contemporary modern societies have been described as characterised by increasing individualization processes and the emergence of more reflexive forms of identity construction (Giddens, 1991; Beck and Beck-Gernsheim, 2002). The growing pressure to succeed and match up to dominant ideals in several domains simultaneously impose a considerable psychological burden for young people in particular, often independent of geographical location, generating uncertainty and personal conflict with negative consequences for individual wellbeing (Perry 2009).

Considering general characteristics of coastal communities, such as physical isolation, low levels of employment and limited educational opportunities, which have been suggested to afflict coastal youths through harmful behaviours and an impairment of mental health (Cave, 2010), one could perhaps anticipate the burdens of increased individualization and identity construction to lay particularly heavy on rural coastal youth. Nevertheless, rural coastal youths exhibited a somewhat smaller increase in poor self-rated health compared to other areas. These variations between areas could be coincidental, but could potentially be seen in view of some rural coastal youths transitioning from an established track into a local and highly physical livelihood in fishing to prospects of employment in a wider range of industries (Vik et al., 2011; Sønvisen et al., 2011; Heggen et al., 2001). The new situation of several Norwegian rural coastal youths may have counteracted potential experiences of isolation and limited opportunities, possibly alleviating the general trend of worsening youth health.

We found statistically significant differences in self-rated health between the rural coastal population and the other geographical categories at both adult and elderly age across all four decades. Considering that we found no such differences in youths, our findings overall indicate that geographical inequalities in health emerge later in life. This could point to the importance of the local labour market in rural coastal areas, and that it perhaps has posed additional hazards to the overall health of the population compared to other geographical areas.

However, decreasing marginal effects of geographical affiliation in adults and elderly indicate that gaps in poor self-rated health between rural coastal areas and the other geographical areas have narrowed over time at these ages. Relatedly, our results showed that the rural coastal population exhibited the biggest decrease in poor self-rated health in adults over time of all areas. This improvement in self-rated health in the rural coastal population, especially in adults, can be assessed in light of the restructuring local labour market. At the time of HUNT1, the number of registered fishers and vessels were at their highest during the total span of HUNT data collection, but at a falling trend. The registered unemployment in the 1980's was also higher in rural coastal areas compared to the national average. As adults at 45 years were likely participants in the local labour market at the times of data collection, we can assume that this group were facing both the health hazards of fishing (Petursdottir et al., 2001; Matheson et al., 2001) and unemployment (Korpi, 2001; Bartley et al., 2006) in this phase of coastal labour market transitioning. This could potentially have put further health strains on the rural coastal workforce compared to other areas. This argument can also extend to the elderly rural coastal population, with many former participants in the local labour market, especially in fishing.

Over the course of the HUNT surveys the number of registered fishers in the county has kept falling. This considerable employment drop in fishing following the major stock crises, combined with technological developments in fishing gear and catching in the remaining fleet (Iversen et al., 2020; Sønvisen et al., 2011), may have lessened the total physical burden on the coastal workforce associated with fishing activity (Petursdottir et al., 2001; Matheson et al., 2001). The current occupation

of fishing entails safer working condition, specialization and recruitment based on larger geographical areas (Sønvisen et al., 2011). Fishing is still an attractive occupation for some people, despite irregular working hours, periods away from home and changing income (Johnsen and Vik, 2013).

At the time of HUNT4, the registered unemployment in rural coastal areas had dropped well below the national level. As reported in the results, rural coastal areas have experienced the biggest increase in registered employees of the geographical categories, despite having a stable sized working-age population (SSB, 2021a). Over the decades following WW2, the national trend of great expansion in the Norwegian public sector has provided new employment opportunities, also in rural coastal areas. The rural coastal labour markets are have become more characterized by public services and private businesses (Vik et al., 2011), and women have explosively entered the labour market from the 1970s (Ellingsæter et al., 2020). Concurrently, accelerating from the mid-1980s, aquaculture has provided several coastal communities with both jobs and economic growth (Steinset, 2017). This trend is apparent in a variety of coastal areas around the world (Betcherman and Marschke, 2016; Nadarajah and Flaaten, 2017), and the former Nord-Trøndelag county has a noteworthy aquaculture activity (Trøndelag Fylkeskommune, 2018).

Earlier findings suggest that governments might be able to protect their populations from health hazards of economic downturns by providing employment opportunities for affected workers (Stuckler et al., 2009). Thus, the transition from a declining local industry to new employment opportunities in a more stable labour market may have been beneficial to the health of the working-age population in rural coastal areas. Correspondingly, social benefits provided through the Norwegian welfare state may have further lessened the potential health hazards of unemployment, as welfare generosity is found to be associated with lower risks of poor self-rated health during recessions (Abebe et al., 2016).

As most elderly respondents also have been a part of the rural coastal workforce, the narrowing gaps in poor self-rated health between rural coastal areas and the remaining areas in elderly indicate that this age group also may have benefitted from the restructuring of labour markets discussed above. Moreover, the narrowing health gaps in elderly could suggest that improvements in public health achieved from restructuring may have reached beyond the workforce itself. Former studies have found poor self-rated health in the general population to increase in correlation with economic crisis and rise in unemployment (Abebe et al., 2016; Astell-Burt and Feng, 2013). Considering that small-scale fishing in rural coastal communities often involved whole households in daily fishing-related activities, with families and communities relying on ocean resources (Jentoft and Wadel, 1984), the decline in fish stocks undoubtably affected the income and security beyond just the providing fisher at the time.

Relatedly, the one-income household structure has to a large extent been dissolved in Nordic countries, also in fishing communities (Vik et al., 2011). Our analyses indicated that the effects of gender on poor self-rated health in rural coastal areas do not significantly differ from the effects of gender in other geographical areas, at all three generations. This may indicate that the reorganization of local labour markets in rural coastal areas, with new employment opportunities in both public sector and aquaculture, might have benefitted self-rated health in both genders.

While we cannot precisely disentangle presumed effects, causalty or relative importance of labour market changes on self-rated health, there is reason to believe that they have contributed to the improvement of rural coastal health. The gaps in self-rated poor health between the rural coastal population and the other geographical areas in adults and elderly started narrowing from the first HUNT Study, during the decline in fishing and public sector investments, and before the greatest developments in aquaculture and fishing technology (Steinset, 2017; Sønvisen et al., 2011). This points to potential combined benefits of developments in both national and coastal-related labour markets on rural coastal health. And despite narrowing gaps between rural coastal areas and the other geographical categories in adults and elderly, it should be emphasized again that rural coastal areas still exhibit a higher prevalence of poor self-rated health compared to other areas at both ages.

4.1. Limitations

Some limitations with our study should be noted. Firstly, the situation of Norwegian rural coastal areas may not be fully generalized to other rural coastal areas. Norwegian rural coastal areas have seemingly benefitted from a national investment of public employment and the innovations in aquaculture and fishing. Accordingly, being a country with well-established welfare services, Norway might exhibit lessened impacts on health from unemployment and economic contractions or expansions compared to other countries. The effect of recession on wages might be weak, combined with generous social benefits (Shahidi et al., 2019). Therefore, one could anticipate other rural coastal areas not to have undergone identical restructuring of the local labour market following the international decline in small-scale fishing. Findings from UK indicate that coastal areas have lower rates of employment, where coastal employment tends to be revolved around low-skilled and highly seasonal labour (Depledge et al., 2017), suggesting that coastal communities not provided with growth in other sectors might have a more vulnerable workforce. There are also concerns that many potential growth sectors in marine technology may not be based in coastal areas (Morrissey, 2017). These factors should be considered in comparisons with other rural coastal areas.

Secondly, our observational study design does not provide conclusions on causal relationships between developments in rural coastal labour markets and self-rated health. Studies have suggested a two-way causality between unemployment and poor health (Tøge and Blekesaune, 2015; Kaspersen et al., 2016). We cannot conclude whether new employment opportunities have caused improved self-rated health directly, or furthermore: whether it has promoted the attraction and upholding of a healthier population. The increasing privileging of formal schooling and human capital formation globally is not without costs, emphasising more individualistic urban lifestyles and work careers, driving young people to leave rural areas (Gulløv and Gulløv, 2020). This is found also in coastal communities (Corbett, 2013). Relatedly, the cross-sectional design of this study does not exclusively follow the same sample, limiting the opportunity to examine changes at an individual or cohort level and factors included in such change. Nevertheless, the repeated cross-sectional design is beneficial in its ability to depict changes on an aggregate level by including every respondent at each cross-section. It should be noted that the response rate declined through the surveys of the HUNT Study. Still, the participation rate has declined in all municipalities, and a nonparticipant study following HUNT3 revealed no significant differences in poor self-rated health between participants and nonparticipants (Langhammer et al., 2012).

Thirdly, some aspects of the study area should be noted. Our study does not stratify on the different rural coastal municipalities. The emergence and development of aquaculture vary between rural coastal communities; not all have experienced the same growth in employment opportunities and societal benefits from this industry (Iversen et al., 2020). Therefore, there might be differences in health developments within the rural coastal population not detected in this study. Nonetheless, the rural coastal areas of this study exhibit work commuting between municipalities (SSB, 2021b), potentially enabling benefits of employment opportunities and economic growth across municipal boarders. Relatedly, potential migration is an often unknown factor when studying geographical disparities in health. Many Norwegian coastal communities faced a substantial outmigration in later half of the 20th century, where people often relocated to more urban areas (Sørlie, 1990; Myklebust, 2001). This type of relocation should still be expected

in rural areas, but in a smaller scale. As selective migrants have been found to exhibit better health (Riva et al., 2011), we cannot rule out potential effects of these moves on population level health.

5. Conclusions

In this study, we calculated predicted prevalence of poor self-rated health at ages 20, 45 and 70 in four geographical categories over four decades. By differentiating between rural coast, urban coast, rural inland and rural fjord, we aimed to compare the health development of rural coastal areas with a history of declining small-scale fishing and subsequent restructuring of local labour markets to other areas. Our results show statistically significant higher prevalences of poor self-rated health in the rural coastal population at adult and elderly age across all surveys of the HUNT Study. Nonetheless, trends indicate improved self-rated health in rural coastal areas at these ages and narrowing health gaps to the remaining geographical area. In youths, the prevalence of poor self-rated health has increased substantially in all geographical categories, however, there were no statistically significant differences between geographical areas. While this study does not offer a conclusive answer to why rural coastal health is improving in adults and elderly, our results shed light on public health in restructuring coastal communities. This study shows that the general level of health has improved in a rural population enduring a substantial decline in one of its most crucial industries. This provides nuances to perceptions of deteriorating public health during times of crisis and emphasizes the potential importance of alternative and lasting local employment opportunities in smaller communities. Further research could benefit from exploring health developments in a wider variety of rural coastal communities facing the decline in small-scale fishing, as employment opportunities and welfare services vary considerably across nations. Our findings and geographical classification hopefully encourage reflections on the definition of coastal areas when assessing geographical inequalities in health. Furthermore, we suggest supplementary qualitative studies about perceived health and well-being across generations in coastal communities to attain more nuanced and in-depth knowledge about the topic of this study.

Credit author statement

Sofie L. Hjorthen: Conceptualization, Formal analysis, Writing - Original Draft, Erik R. Sund: Conceptualization, methodology, Writing - Review & Editing, Anne Trine Kjørholt: Writing - Review & Editing, Miriam Hjeldsbakken Engevold: Writing - Review & Editing, Steinar Krokstad: Conceptualization, Writing - Review & Editing, Supervision.

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Declaration of competing interest

None.

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