The effect of exemption from co-payment on adolescent utilisation of primary health care

The case of Norway

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Abstract

Background: In Norway, children and adolescents under a specific age have been exempted from co-payment when they consume health care service provided by a GP. The age threshold for co-payment has been raised several times in the country. At the latest revision, the threshold was raised from 12 to 16 years of age effective July 1, 2010. Previous studies found that exemption from co-payment led to an increase in consumption of health care. However, there seems to be scarcity of studies investigating the effect of exemption from co-payment on the number of GP contacts by adolescents in the Scandinavian region. The socio-economic environment of the countries studied seems to be different from the Norwegian context.

Aim: The aim of the study was to investigate if exemption from co-payment was significantly associated with an increase in the number of GP contacts among adolescents.

Method: All adolescents born in 1998, 1996 and 1994 and who had at least one GP contact in one or more of three observation years constituted the study sample (N=357,724). A sample consisting of three birth cohorts allowed analysis of the effect of co-payment policy on adolescents of different ages. The data was obtained from the KUHR database of the Norwegian Directorate of Health. A Poisson regression model was fitted because the dependent variable was a count data and had non-normal distribution. GLM was used to fit a Poisson regression so that the dependent variable – GP contacts – is linearly related to the explanatory variables via a log-link function. The model was controlled for possible confounders including patient’s sex, age, birth cohort, proportion of contacts with male GP, and proportion of contacts with non-specialist GP.

Results: Mean GP contacts of 9-17 year-old adolescents was 3.06 [95% CI (3.05 , 3.07)] per year. Adolescents exempted from co-payment had significantly more GP contacts when compared with their peers who were not eligible for exemption (p-value < 0.005). Marginal effect of exemption, ceteris paribus, was predicted and exemption from co-payment was associated with an increase of 0.26 GP contacts in a year. This means that adolescents not required to share the cost of health care, increased their number of GP contacts by 0.26 per year compared to their peers who paid the co-payment fee. Patient’s gender, age and birth cohort were also found to have significant association with the number of GP contacts.

Conclusion: Exemption from co-payment is significantly associated with an increase in the number of GP contacts among adolescents. The findings uncover the importance of raising the age threshold further to exempt young people in their late adolescence as older adolescents are responsive to exemption from co-payment and have more health care needs compared to younger adolescents.

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Abbreviations and acronyms

GLM	Generalised Linear Model
GP	General practitioner
HELFO	The Norwegian Health Economics Administration
KUHR	Control and Payment of Health Reimbursements
NIS	National insurance system
PLS	Patient list system
RRR	Relative rate ratio
SPSS	Statistical Package for Social Sciences
WHO	World Health Organisation

1 INTRODUCTION

Cost-sharing has been widely used, at least in the health care systems of western countries, with all its merits, drawbacks, and differential effect on health care users from different socio-economic groups (Olsen, 2009; Folland et al, 2013). One of the main mechanisms of cost-sharing is co-payment where a patient, as an insured party, is required to pay a flat fee per unit of health care service (Robinson, 2002). A change in co-payment was found to have significant effect on the demand for health care service. An inverse relationship between co-payment and level of health care consumption was previously reported and the ultimate objective of co-payment has been to control unnecessary consumption or to generate additional revenue to finance health care provision (Nolan, 2007; Winkelmann, 2004). Thus, co-payment results in financial burden to health care users.

The burden of out-of-pocket payment, which is conventionally measured as a share of total household income or by its share of total household consumption, constituted 3.4% as a share of final household consumption in Norway in 2009. This was slightly higher than the average for OECD countries of 3.2% (OECD, 2011). However, Norwegian children and adolescents under a specific age limit have been exempted from co-payment for medical services provided by GPs regardless of the economic situation of their parents. Health care provided by GPs to adolescents has been fully subsidized by the National Insurance System (NIS).

There are various justifications for subsidizing primary health care for adolescents. Firstly, health can sustain by ensuring better access to adequate and appropriate preventative health care for adolescents (Kleinert, 2007). That is, the establishment of relationships with the health care system during adolescence is considered important to provide necessary and timely support for healthy lifestyles and to provide interventions for those with unhealthy behaviours (Zimmer-Gembeck et al, 1997). Secondly, improving access to vulnerable social groups enables a health care system to ensure more equitable distribution of health care to users (Olsen, 2009).

It can be claimed, at this point, that exemption from co-payment provides adolescents with better access to primary health care by removing financial burden related to consumption of the service. Therefore, exemption from a co-payment fee that imposes financial burden of not more than a moderate level, is expected to significantly increase adolescents' demand for health care which is defined in the present study as the number of GP contacts per year.

However, our expectation of increased use of health care by adolescents due to their eligibility for exemption has not been supported with sufficient context relevant evidence. There seems to be scarcity of literature about the effect of removing co-payments on health care demand among adolescents in the Scandinavian region generally and in Norway specifically. Furthermore, the socio-economic context of the countries studied seems to be different from the Norwegian context. The scarcity of context-relevant evidence of association between exemption from co-payment and health care consumption among adolescents was, therefore, the reason for conducting the present study.

This scarcity of evidence is not without consequence. There is a possibility for less efficient allocation of resources without addressing equity issues when information relevant to economic decision-making is lacking. Scarcity of information that could be used as input in economic decision-making may lead to uncertain outcomes.

The aim of the study was to investigate if exemption from co-payment was significantly associated with an increase in the number of GP contacts among adolescents. Thus, the question was:

Did adolescents exempted from co-payment have more number of GP contacts as compared to their peers who were required to pay a co-payment fee?

Based on this question, the following three hypotheses were formulated:

i. Adolescents who had been exempted from co-payment had significantly more GP contacts when compared with their peers who paid co-payment fee.

ii. Consumption of health care provided by GPs increase with age during adolescence.

iii. Raising the age threshold for co-payment provides older adolescents with better access to primary health care.

The present study responded to the aforementioned research question by confirming the existence of significant association between exemption from co-payment and increased number of GP contacts among adolescents by using data from recent years and fitting a Poisson regression model.

The thesis is organized in eight chapters. Chapter 1 is the introduction to the thesis and includes the research objective and hypotheses. Chapter 2 presents background information on Norwegian and international experiences. Chapter 3 raises health issues of adolescents. Chapter 4 includes the theory of health care demand and theoretical explanations of co-payment. Furthermore, the peculiar aspects of health demand are presented in this chapter. Chapter 5 is devoted to study methods, presents the study design, describes the sample, defines the variables used, and explains the analytical model. In chapter 6 descriptive statistics and regression results are presented. Discussion of findings, strengths and limitations, and policy implications are included in chapter 7. Chapter 8 is used to conclude.

2 BACKGROUND

Treatment costs were mentioned by patients as one of the main reasons for not receiving health care (OECD, 2011). Thus, it becomes relevant and of high significance to study the influence of out-of-pocket payments on the demand for health care service provided by GPs.

2.1 The Norwegian experiences

In Norway primary health care by GPs has been provided within the context of a Patient-List System (PLS) the objective of which is to improve the accessibility and quality of service by ensuring that every inhabitant in the country has the right to register with a regular GP. Close to 100 per cent of the general Norwegian population and GPs participate in the system (Iversen and Lurås, 2008).

Patients are required to pay a co-payment fee in order to share the treatment cost with a public health insurer – NIS – when they consume health care service provided by a GP. The amount of income a GP earns for each consultation consists of a fee-for-service and a capitation fee for each patient in the patient list of the GP, both reimbursed by NIS, and a co-payment fee directly paid by the patient. In 2010, for example, the capitation fee was NOK 372 per patient per year. In the same year, co-payment for GP consultation was NOK 136 if the GP did not have specialist status in general medicine, and NOK 180 if the GP were specialist in general practice (Onlinelege, 2011).

As part of the Norwegian health system's effort to secure universal coverage of high quality health service, children and adolescents under the age of 16, pregnant women, patients living with HIV/AIDS, young people under the age of 18 who receive treatment from a psychologist, and those who have reached an upper limit for out-of-pocket payments have been exempted from co-payment (HELFO, 2013). Since age is one of the factors that influence utilization of health care with some evidence of a U-shaped relationship between age and service utilization (Scott, 2000), exemption of young people in their early and middle adolescence is meant to remove financial burden of health care service and encourage them to make use of the service at times of need. For this reason, the age threshold for co-payment in Norway has been raised several times so that those who previously had to pay co-payment fee, no longer have to. Accordingly, the age threshold for co-payment was raised from 12 to 16 years of age at the latest revision on July 1, 2010.

The effect of co-payment depends on the financial burden of the fee paid out-of-pocket by the patient. A substantial change in the amount of co-payment is likely to have an effect of a price in influencing the demand for health care (Folland et al, 2007). This implies that exemption from co-payment can have an effect on health care consumption if the fee paid out of pocket was considered to be substantial by the patients. In the Norwegian health care system, out-of-pocket payments accounted for 37% of total costs; seen as a proportion of total health care expenditure, out-of-pocket payments made up 15% in 2009, reflecting moderate level of cost-sharing requirements (Lindahl and Squires, 2011), which implies that exemption thereof may have actual moderate effect on increasing the demand for primary health care services provided by GPs. However, the relatively small co-payment fees and the presence of a limit on personal health care expenses in the form of deductibles, were not considered to be barriers to health care service in Norway and Sweden (Holm et al, 1990).

2.2 International experiences

International experiences of co-payment have revealed the effect of changes in co-payment fees on reducing or increasing health care consumption. Nolan (2007) studied the effect of exemption from co-payment on the number of GP visits in Ireland. During the study period, all individuals were eligible for universal public health insurance by paying a significant amount of co-payment fee for GP visits. However, the poor and the unemployed were exempted from co-payment and they had a “medical card” that entitled them to free medical care. The size of the population who effectively face a zero monetary cost in visiting their GP due to such eligibility was estimated to be nearly 30% of the total Ireland’s population. By using panel data from the dataset known as *Living in Ireland Survey* of 1995-2001, the aforementioned author compared GP visits of the exempted group with the non-exempted group. By controlling for demographic, socio-economic and health status characteristics, a comparison of medical card patients and private patients, who pay the full cost out-of-pocket, showed that exemption from co-payment through medical card eligibility was one of the few non-need factors that had significant effect on GP visits. Having a “medical card” which entitled the patient to completely free care, led to an increase of 0.33 GP visits per year. The author considered this marginal effect of 0.33 GP visits to be a large difference between the consumption levels of the exempted group and co-payment fee payers.

Based on German experiences, Winkelmann (2004) conducted a natural experiment to study the indirect effect on doctor visits of co-payment fees that increased up to 200% by the German health care reform of 1997. Using a differences-in-differences method he found that an increase in co-payment fees for prescription drugs reduced not only the consumption of prescription drugs, but also the number of doctor visits by about 10% on average. This study compared social groups exempted from the increase in co-payment which included people with private insurance, children under the age of 18, and poor people, with the group that was required to pay higher co-payment fee. The main purpose of raising the co-payment fee in Germany was to reduce cost of health care by reducing excessive consumption of prescription drugs; because an estimated quarter of all prescriptions received by patients did not have confirmed therapeutic benefits.

RAND health insurance experiments are widely known studies from the USA that discuss the effect of cost-sharing on health care consumption. Based on such experiments, Keeler (1992) presented the effect of cost-sharing on health care consumption. The experiment randomly assigned 5809 people to insurance plans that either had no cost-sharing, or 25%, 50%, or 95% co-insurance rates. Several findings worth noting were presented from this experiment. One of the findings indicate that, if patients were required to pay the full bill of treatment, the actual health care spending of the patients would have fallen as low as half of the total health care cost they received for free. This is because cost-sharing reduces the number of treatment episodes of all kinds. The findings also showed that there was a differential effect of cost-sharing on socioeconomic groups with poor people being less likely to seek care in a year and more likely to be hospitalized, when compared with the richer counterparts, regardless of the extent of the co-payment fee charged. This raises equity issues of cost-sharing as poor people are more adversely affected.

The RAND health insurance experiment also revealed that cost-sharing has health effects on health care consumers. The people who were exempted from cost-sharing had better health results at the end of the study on blood pressure control, corrected vision, and oral health. Thus, cost-sharing has a wide range of effects including reduction in total health care spending, reduction in demand for health care, more adverse effects on poor people and poorer health results to those who are required to pay out-of-pocket payments.

Another study of RAND Health Insurance Experiment investigated the effect of cost-sharing on the use of medical services by children under the age of 14 years (Leibowitz et al, 1985).

1,136 children participated in this experimental study which entitled parents of some of the children to 100% reimbursement of the children's health care costs, and let the rest of the parents pay out-of-pocket 95% of the cost of medical care for their children. The findings of this experiment showed that for both younger and older children, the probability of having at least one visit for medical care decreased as the proportion of cost-sharing increased and as the children's age increased. As a result of cost-sharing, the average number of outpatient visits also decreased.

All the aforementioned country experiences of cost-sharing and its effect on demand for health care agree in their findings that cost-sharing is inversely related to demand for health care for both adults and children regardless of socio-economic factors of the country under consideration. The present study builds on these and other relevant literature. The unit of analysis is an adolescent patient in an observation year. Its findings are expected to contribute to the existing literature by estimating the association between exemption from co-payment and adolescents' demand for health care service provided by GPs. It may also be used to identify important research questions.

3 HEALTH AND ADOLESCENTS

3.1 Health care needs of adolescents

Adolescents' access to adequate and appropriate health care is advocated for by researchers and practitioners alike in order to enable health care systems to tackle the health challenges of young people. A review of teenagers' perceived needs and access to primary health care in the United Kingdom (UK) found that a substantial minority, up to 30% depending on the problems, reported to have had unmet health care needs (Gleeson et al, 2002). The concern with poor access to health care by adolescents stems also from the fact that adolescents with poor health status were most likely to report underutilization of health care facilities and unmet health needs (Britto et al, 2001). Unmet health care needs related to mental health, sexual health, and lifestyle problems especially drug and alcohol abuse was uncovered in a study of 12-17 year-old adolescents (Epstein et al, 1989). Such health problems and lifestyle factors are possible predictors of ill health in adult life and are partly preventable (Hetlevik et al, 2010).

According to Kleinert (2007), overweight and obesity, among young people, have been increasing in developed countries, and for the first time there is now a danger of a substantial drop in life expectancy with chronic diseases, such as diabetes and early signs of cardiovascular disease appearing in teenagers and young adults. Taking these challenges into consideration, there is a need to view adolescent health as an opportunity, and not just as a challenge, in order to sustain health and wellbeing both in adolescence and adulthood. A study from Scotland described the lack of mental well-being in 15 year-olds as undiscovered iceberg when a study revealed that the self-reported rate of psychiatric morbidity was nearly seven times greater than that suggested by the same study participant's medical records (Potts et al, 2001). Thus, these and other related accounts of health care needs of adolescents justify the use of mechanisms that enable adolescents to establish stronger relationships with the health care system for adequate and timely service (Zimmer-Gembeck et al, 1997).

3.2 The need for adolescent friendly health care

One of the five components of WHO's framework for the development of youth-friendly health services is the provision of free or affordable health services for young people (Tylee et al, 2007). The main factors that reduce the number of young people's contact with their GP were found to be service fee and delayed delivery of service (Tylee et al, 2007; Gleeson et al, 2002). Furthermore, children's and adolescents' health is influenced by the financial resource of their parents and strong association was found between low income of parents and poor health outcomes of children (Lucas et al, 2012). Poor health outcomes in childhood often sustain in adulthood. These previous findings imply that the removal of health care fees make health care service adolescent-friendly and enables adolescents to have better access and utilization of health care services.

A focus on building the health stock of adolescents is expected to contribute to avert the noticed drop in life expectancy. This means, investment in children's and adolescents' health through fully subsidized primary health care is justified due to the opportunities it renders for sustained health through provision of adequate and appropriate preventative health care.

4 THEORY OF HEALTH CARE DEMAND

4.1 Primary health care

Primary care is widely perceived to be the backbone of a rational health service system. At least in Europe, the general practitioner is often considered to be the type of practitioner who delivers primary health care. A GP is defined as a physician providing personal, primary, and continuing medical care to individuals and families where the long-term relationships are the defining element of general practice (Burke et al, 1993). Some of the peculiar features of primary health care include affordable cost, first-level contact, and first elements of a continuing health care process. Thus, a GP is regarded as the main point of entry to health care services. In addition to the health care service they provide, GPs ensure the provision of necessary medical service by directing and linking a patient to a private specialist or a hospital. Patients' contact with the health care service depends largely on their contact with a GP. A strong primary care orientation of a health care system renders the primary care in general and GP services in particular accessible in order to attain better health levels.

According to Starfield (1994), countries that had a higher average score than their counterparts for primary care orientation were found to have a population of better health levels. That is, among western industrialized nations, a primary care orientation of a country's health service system was found to be associated with lower costs of care, higher satisfaction of the population with its health services, better health levels, and lower medication use. Average score for primary care orientation in each of the 11 countries studied was computed first based on 11 features of primary care among which family centeredness, first-contact care, comprehensiveness, and coordination were the characteristics that reflected the performance of primary care practice. The countries were ranked according to their primary care scores and these ranks were compared with "outcome" indicators including level of patient satisfaction and health levels as measured by 14 health outcome indicators. The findings reasserted that primary care orientation of a health care system was associated, among others, with better health levels. Measures that improve access to health care provided by GPs indicate strengthening of primary health care orientation.

4.2 Health care demand

4.2.1 Aspects of health demand

The demand for health differs from the traditional approach to demand in many ways (Folland et al, 2013). Consumers purchase health care because they want to improve their health or to protect it from a decline. The demand for health care arises due to the consumer's demand for health; thus, demand for health care is a derived demand. In other words, the demand for health care depends largely on the consumer's judgement about the utility they get directly or indirectly from their health, and not by the utility they get from consuming the health care service itself. However, people do not confine themselves to meeting their demand for health, only through the consumption of health care service purchased at the market. Rather, they actively produce health by having better life style and health promoting behaviours including better diet, physical exercise, and active engagement in social activities, as well as avoidance or minimisation of risk behaviours such as smoking and excessive alcohol consumption. Consumers, as rational decision-makers, do not want to make unnecessary spending out of their pocket. In order to reduce unnecessary medical care spending, they actively produce health and protect themselves from disease. Thus, requirement of cost-sharing incentivises people to actively produce health.

Health gained by the use of medical care or own health producing efforts lasts for more than one period making health to have an attribute of a capital good that does not normally depreciate within the period consumed. A person's stock of health capital determines the ultimate output of healthy state of life that includes physical health, mental health, and social activity. Better access to health care is, therefore, important for healthy state of life of the health care consumer. A healthy state of life is desired for two benefits. Firstly, it makes people have better satisfaction in life as they feel good due to better heath; secondly, it positively influences the productivity and ability of people to earn more income. While the benefit is related to health as a consumption good, the second benefit emphasizes the importance of health as an investment good that generates long-term benefit.

The amount of health stock depends on the amount of investment made in terms of time and money in which case the latter depends in return on the price of health care services and drugs that influence the demand for health care. Thus, health capital and its improvement, rate of depreciation, or sustainability partly depends on the investment made in building the health stock which in turn depends on the ability and willingness of the consumer to invest in improving health capital. An individual's decision to invest in health capital is done in the context of patient payment arrangement in a given health care system. The arrangement may require a patient to pay the full cost or only a certain percentage of the cost of health care. A generous health care system may provide health care service without requiring the patient to make out-of-pocket payments. Detailed theoretical explanation of patient payment arrangements is available in Section 4.2.3.

4.2.2 The patient as a consumer of health care

As health demand differs from the traditional approach to demand, the patient also differs from a consumer of an ordinary good. Olsen (2009) discussed how a patient is viewed as an 'autonomous consumer' and a 'compliant consumer' who visits a physician first based on one's own autonomous decision and who afterwards tends to comply to recommendations of the physician. Both autonomous and compliant decision-making behaviours of a patient are present due to the peculiar characteristics of the health care market. The peculiar characteristic is that the patient lacks diagnostic and treatment information. By virtue of their professional expertise, physicians possess information about the impact of health care on health and effectiveness of alternative treatments. As a result of this information asymmetry, a patient is inclined to delegate decision making concerning whether or not to consume health care to the physician. When a patient's demand for health care is influenced by a physician's recommendation concerning whether or not to consume health care, we call the patient a compliant patient.

The extent of demand for health care by a compliant patient partly depends on the incentives the physicians attach to their own recommendations. A physician induced demand, which is the health care demand of a compliant patient, is expected to be higher in health care market where the physicians have financial incentive to recommend more health care service. This happens when physicians are reimbursed by a third party payer according to the units of service consumed by the patient. Based on the trust patients have on physicians they are likely to comply with the physician's recommendations. In addition to this, physicians who focus only on satisfying the needs of an individual patient by disregarding the interest of the third-party payer would recommend more health care, in terms of quantity and quality, than if the patient had to pay out of their own pocket. Thus, in the case of demand for health care, the demand that occurs based on the patient's own decision and demand induced by a physician are inseparable. It is worthwhile to note that in the present study demand encompasses all GP contacts regardless of whether they were made by a 'compliant patient' or by an 'autonomous consumer'. Generally, induced demand is more common among health care consumers who are exempted from cost-sharing arrangements than patients required to make out-of-pocket payment.

4.2.3 Effect of co-payment on health care demand

Patients are required to share the cost of health care consumed with a third party payer who subsidises them. There are direct and indirect cost-sharing (Rubin and Mendelsen, 1995). Direct cost-sharing refers to an arrangement where fees are directly imposed on patients when they make use of health care services. Co-payment and deductibles are among the user fees that are directly imposed on patients. In the case of deductibles, the service user is required to pay the first specified amount of health care cost before insurance coverage begins. Co-payment, which is the main focus of the present study, is imposed as a flat fee per health care service.

Figure 1 illustrates the effect of co-payment on demand for health care. The illustration was borrowed from Folland and co-authors (2013); an alternative source is Barros and Martinez-Giralt (2012). Health care consumption varies with changes in the amount of co-payment fee paid by the patient. The amount of and limits to out-of-pocket payment have effect on a society's ability to achieve efficient allocation of resources. Efficient allocation occurs when the cost of delivering the health care service to the market (marginal cost) equals to the amount the consumers are willing to pay for the service (marginal benefit).

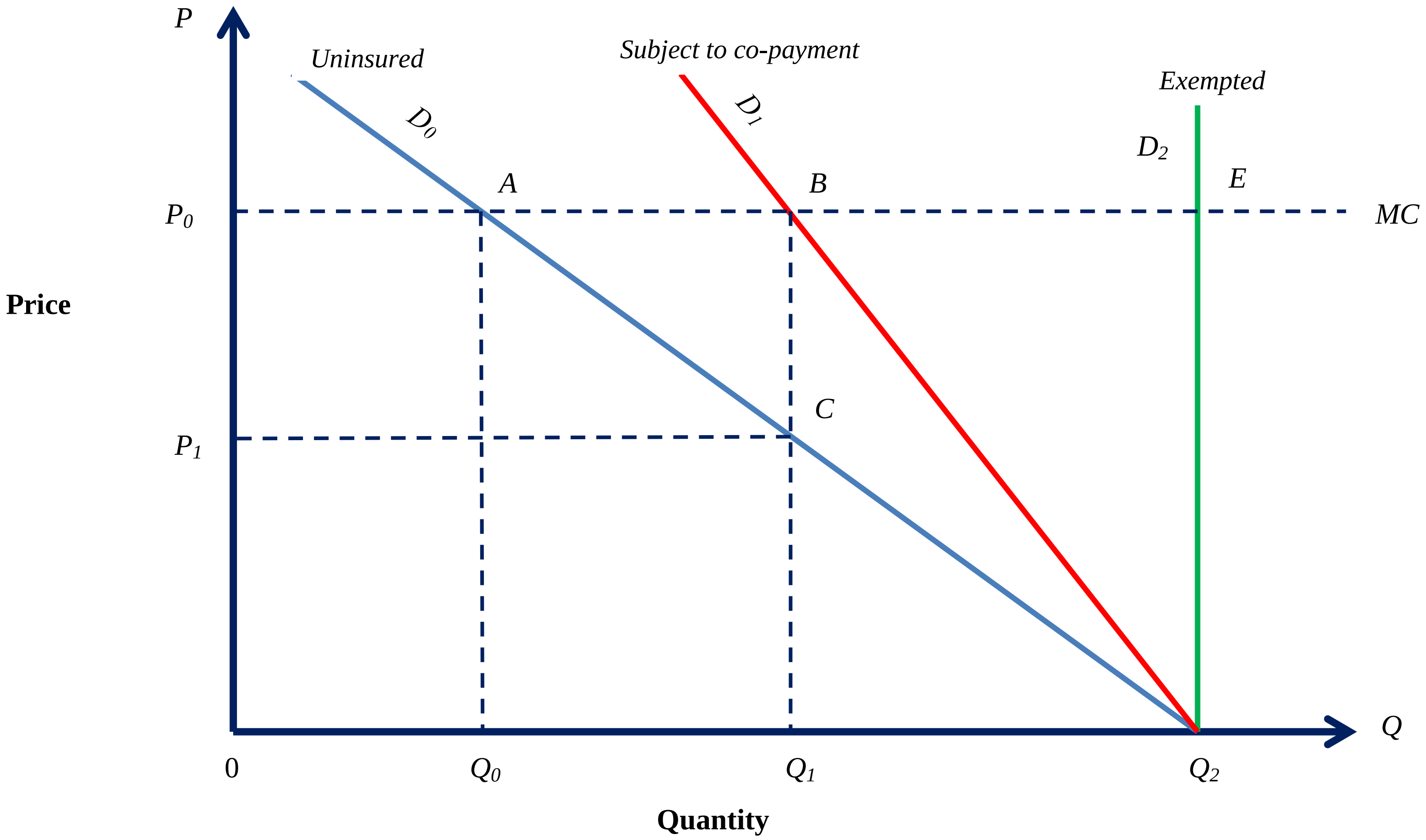
The demand for care by a consumer is illustrated under three different situations of insurance, assuming that the individual's demand for health care is price elastic. We also assume that the marginal cost of care, P_0, is constant regardless of the different insurance situations. In the first situation the patient is assumed to be uninsured and has to bear the full cost of health care, P_0; thus, she prefers to consume Q_0 units of health care. This shows that, based on the consumer's preferences, the marginal benefit which is described by point *A* on the demand curve, D_0, equals the marginal cost, P_0, showing an efficient allocation of resources for society. The price, *P*, reflects the cost of health care to the society and includes costs related to time, transport, and the cost of bringing the service to the market.

In the second situation, the consumer has a health insurance contract where she is required to pay only a co-payment fee, P_1, which is, for example, equal to 20 per cent of the health care bill. The demand curve, D_1, was generated leading to a new equilibrium quantity demanded Q_1. Thus, the incremental cost of the service provided is $P_0 \times (Q_1 - Q_0)$, or the rectangle ABQ_1Q_0. The incremental benefit to the consumer is represented by the area ACQ_1Q_0. Since the consumer is now consuming more health care than is optimal, the resulting loss in well-being is represented by triangle *ABC*. In other words, this loss in well-being has occurred because the incremental cost of delivering health care service ABQ_1Q_0 is larger than the marginal benefit ACQ_1Q_0 by triangle *ABC*.

In the third situation, where there is exemption from co-payment, the consumer receives full insurance coverage for a net price of $P = 0$. Her consumption of health care is fully subsidized. The demand curve in this situation is labelled with D_2 and the consumer's demand for health care increases now from Q_1 to Q_2. In such insurance situation, the total health care expenditure to society is P_0Q_2; this expenditure is fully borne by the insurer. The fully covered patient limits her demand at *Q2* because of costs related to time, transport and other factors that result in cost when consuming health care. A change from the first situation to the third situation, results in incremental cost AEQ_2Q_0 and incremental benefit of AQ_2Q_0. Since the incremental cost exceeds the incremental benefit, the loss in well-being is AEQ_2. This means that the society's loss of well-being is larger in situations where consumption of health care is fully subsidised than in situations where consumers are required to pay a co-payment fee. In other words, exemption of health care consumers from co-payment results in less efficient allocation of resources as compared to requiring consumers to share cost of health care provided.

The explanations, above, reveal that insurance implicitly subsidises insured types of care relative to other types of care; it also subsidises insured types of care relative to non-health goods. The subsidy leads to distortion in allocation of resources in a society and this distortion is larger when there is exemption from co-payment than when co-payment fee is applied in the insurance system.

Figure 1. Effect of co-payment on health care demand.



Source: Folland et al 2013, p. 163.

5 STUDY METHOD

5.1 Data and sample

In an effort to respond to the research question, I have employed a cohort study design. Data from three cohorts were pooled to estimate the number of GP contacts assuming that the slope coefficients and variances of the three cohorts were identical. The data was pooled because the features of the data available did not allow the use of other designs such as differences-in-differences estimator by employing panel data analysis. The reason for choosing cohort design was to make use of the advantage of large sample and to avoid selection bias.

5.1.1 Data and its source

The data used for the present study was obtained from the KUHR database which was owned by the Norwegian Directorate of Health. KUHR functions pursuant to the Norwegian National Insurance Act and consisted of, among others, data related to reimbursement to GPs for the health care service they provided to primary health care service users. The report sent by each GP is required to contain data about the GP (ID, type of business, code of practice municipality), patient (ID, sex, age, code of residence municipality), treatment (time of GP contact, amount reimbursed, type of service rendered), and diagnosis (Cappelen, 2012).

The advantage of using the database was that the data files supplied to the researcher were without missing values except for the residence municipality of the patients during the first two observation years. However, KUHR did not include some of the variables that were relevant for the present study. This has caused the exclusion of some possible confounders from the fitted model. Furthermore, only those who had at least one physician contact in a given calendar year were included in the database causing non-inclusion of a sizeable proportion of cohort members with zero GP contacts.

5.1.2 The sample

The sample included three birth cohorts. These were cohort 1994, 1996 and 1998. By cohort, it is meant the calendar year in which the adolescents were born. The reason for selecting these three cohorts was to allow comparison among various age groups on the one hand, and between the exempted and non-exempted groups on the other hand. Because the age threshold for co-payment was raised from 12 years to 16 years of age effective July 1, 2010, we decided to include those who were 15 year-old adolescents in the year 2011 which was the last observation year in the present study.

While birth cohort 1994 was not exempted throughout the observation years, birth cohort 1998 was eligible for exemption throughout the study period. The birth cohort in the middle – birth cohort 1996 – was not required to pay co-payment fees during the first and the last observation years; but did during the second observation year. This mix of cohorts has enabled to have a good representation of the exempted and co-payment fee paying adolescents. The sub-samples that constituted the study sample are presented in Table 1.

Table 1. Sample overview of the number of observations by cohort and observation year (age in parenthesis) (N=357,724).

	Observation years			
		2007	**2009**	**2011**
Cohort	**1994**	*34,411* (13)	*40,984* (15)	*47,001* (17)
	1996	*37,428* (11)	*39,004* (13)	*44,930* (15)
	1998	*35,877* (9)	*38,181* (11)	*39,908* (13)

Exempted | Not-exempted

The KUHR database consists of only patients who had at least one physician contact during a given observation year. Thus, the sample in the present study (N=357,724) included adolescents from the aforementioned three cohorts who had at least one GP contact in a given observation year. A patient's GP contacts in one observation year were assumed to be independent of his/her GP contacts in a different observation year. Therefore, the same individual who had GP contact, for example, in observation years 2009 and 2011 but not in 2007, was counted twice in the sample. Thus, the unit of analysis is a patient in an observation year.

5.1.3 Ethics

The subjects in the study were represented by a pseudo identification number when the data were retrieved and sent for the study by the Norwegian Directorate of Health; thus, anonymous data.

5.2 The dependent and predictor variables

5.2.1 Dependent variable

The dependent variable was the number of GP contacts counted in a given observation year. GP contacts in the present study was defined to mean any type of contact with the purpose of receiving health care service from a GP and that results in out-of-pocket payment to the user if not eligible for exemption from co-payment. Included in the variables are, simple GP contacts such as a visit to a GP by the patient or a third party representing the patient; contact through writing or telephone call that may result in issuance of a prescription or sick leave certificate; GP consultation; and a visit by the GP to the patient ("sykebesøk").

The dependent variable was measured by counting the number of GP contacts in a year where the minimum and maximum values were 1 and 8, respectively.

5.2.2 Predictor variables

The following is a brief explanation of the predictor variables used in the present study. Only variables for which data could be found in the KUHR database were used.

Exempted was the main explanatory variable and it refers to the adolescents who were not required to pay out-of-pocket when receiving health care service from a GP. In this dummy variable, "payer" was the reference category and it refers to those adolescents who were not exempted from co-payment. In order to obtain more accurate estimate of the effect of exemption from co-payment, the model was controlled for the following potential confounders.

Boy was a dummy variable for the adolescent's gender where "girl" was the reference category.

Cohort 1994 denotes a birth cohort and it is defined to mean the adolescents who were born in 1994. Birth “cohort 1998” was the reference category.

Cohort 1996 denotes a birth cohort and it is defined to mean the adolescents who were born in 1996. Birth “cohort 1998” was the reference category.

Age of the adolescent refers to the time period, in years, from birth to year of observation. The same adolescent who had been observed in three different observation years had accordingly three different ages in the dataset. “Age” was a continuous variable with values 9, 11, 13, 15 and 17.

Proportion of contacts with male GP (Propor_m) refers to the proportion of contacts an adolescent had with a male GP in an observation year. The values of the variable are in the interval (0, 1). Physician gender influenced physician contacts (Gleeson et al, 2002).

Proportion of contacts with non-specialist GP(Propor_ns) refers to the proportion of contacts an adolescent had with a GP who was not specialized in general practice. Physician specialisation influenced physician contacts (Bornstein et al, 2000).

A brief definition of the variables and related descriptive statistics are presented in Tables 2 and Table 3, below. Table 2 shows variables used in the analytical model and their operational definitions in brief. Eight variables were used.

Table 2. Definition of variables.

Variable	**Definition**
GP_contacts	A dependent variable expressed as a count of GP contacts.
Exempted	DUMMY, = 1 if patient was exempted from co-payment; 0 otherwise.
Boy	DUMMY, = 1 if patient was a boy; 0 otherwise.
Cohort 1994	DUMMY, = 1 if patient was born in 1994; 0 otherwise.
Cohort 1996	DUMMY, = 1 if patient was born in 1996; 0 otherwise.
Age	Age of patients in years.
Propor_m	Proportion of contacts with male GP.
Propor_ns	Proportion of contacts with non-specialist GP.

With the exception of Age, Propor_m and Propor_ns, all of the independent variables were dummy variables. Table 3 shows that mean age was 13.18 years and the average number of GP contacts was 3.06.

Table 3. Global descriptive statistics (N=357724).

Variable	**Mean**	**Std. dev.**
GP_contacts	3.06	2.22
Exempted	0.45	0.50
Boy	0.50	0.50
Cohort1994	0.52	0.50
Cohort1996	0.52	0.50
Age	13.18	2.34
Propor_m	0.67	0.42
Propor_ns	0.52	0.44

5.3 Study model and data analysis

5.3.1 Poisson regression model

The random variable in the present study is a count of the number of GP contacts during an observation year. When the response variable is in the form of a count, there is a need to fit a regression model that is appropriate for count data. Counts are all positive integers and a Poisson distribution, rather than a normal distribution, is more appropriate since the Poisson mean > 0; a peculiar feature of Poisson distribution is that the dependent variable has variance equal to the mean (Hill et al, 2012).

The natural logarithm of the response variable is linked to a linear function of predictor variables in the fitted log-linear model as shown in equation 1, below:

$$\ln(\text{GP contacts}_i) = \beta_0 + \beta_1 \, Exempted_i + \beta_2 \, Boy_i + \beta_3 \, Cohort1994_i + \beta_4 \, Cohort1996_i + \beta_5 \, Age_i + \beta_6 \, Propor\_m_i + \beta_7 \, Propor\_ns_i, \quad \textbf{(1)}$$

where: ln(GP contacts) is the natural logarithm of the number of GP contacts,

β_0 is the intercept,

$\beta_{1,\ldots,}\ \beta_7$ are the coefficients of the corresponding predictor variables, and

$_i$ denotes an observation number; for example, $Exempted_i$ is indicator whether there exemption in the observation under consideration.

Linking the dependent variable to the factors and covariates on the right hand side of equation 1, above, we have a log-linear model where a coefficient, for example β_1, represents the expected change in the logarithm of GP contacts due to a change in the predictor variable – *Exempted*. In order to predict GP contacts based on the coefficient of the predictors, we take the anti-logarithm:

$$\text{GP contacts}_i = \exp[\ln(\text{GP contacts}_i)] = \exp(\beta_0 + \beta_1\, Exempted_i + \beta_2\, Boy_i + \beta_3\, Cohort1994_i + \beta_4\, Cohort1996_i + \beta_5\, Age_i + \beta_6\, Propor\_m_i + \beta_7\, Propor\_ns_i). \quad \textbf{(2)}$$

Where: *exp* is the base of a natural logarithm with a value of 2.71828.

In this model, the value obtained by exponentiating a coefficient of a variable, for example, $\exp(\beta_1\, Exempted_i)$ is referred to as the relative rate ratio (RRR) and is used to measure the effect of the predictor variables in the present study. Conditional mean GP contacts were predicted based on the combined effects of the exponentiated terms on the right side of equation 2, above.

In studies where the dependent variable in a regression model is a count of number of occurrences of an event, there is often interest in explaining and predicting probabilities. Predicting the probability of making different number of GP contacts during a year was done in the present study using Poisson probability distribution. Considering *Y* to be the number of GP contacts in the present study, if *Y* is a Poisson random variable, then its probability function is:

$$f(y) = P(Y = y) = \frac{e^{-\lambda}\lambda^y}{y!},\ y = 0, 1, 2, \ldots\ , \qquad \textbf{(3)}$$

where λ is the mean of *Y*, and y is any number of GP contacts for which we estimate the probability of occurrence. In this function, the mean is assumed to be equal to the variance;

thus, λ is also the variance. In a regression model we try to explain the dependent variable *E(Y)*, that is the predicted GP contacts, as a function of some explanatory variables. Keeping the value of $E(Y) \geq 0$, we define Poisson regression model for count data as follows:

$$E(Y_i) = \lambda_i = \exp(\beta_0 + \beta_1 Exempted_i + \beta_2 Boy_i + \beta_3 Cohort1994_i + \beta_4 Cohort1996_i + \beta_5 Age_i + \beta_6 Propor\_m_i + \beta_7 Propor\_ns_i). \quad \textbf{(4)}$$

Poisson distribution can be used to approximate the binomial probabilities in situations where the number of trials, n, is large and the probability, P, of occurrence of an event is small. In such situations is estimated that $\lambda = nP$ (Newbold et al, 2010).

5.3.2 Data preparation and model selection

When the dataset was received from the Norwegian Directorate of Health, data related to the same person were presented in multiple rows depending on the difference in the gender and specialization status of the GPs contacted during a given observation year. For example, if a patient had contact with a male GP and a female GP in the same observation year, the GP contacts were entered separately in two rows because the two GPs contacted were of different sex. Likewise, if a patient had contact with a GP who had specialist status in general practice and with another GP who was not specialist in general practice, the number of GP contacts for the same patient were entered in two different rows; one for each GP type. Thus, the data set was restructured using SPSS in a way that all of a person's number of GP contacts and values of predictor variables were entered in one row to suit for the fitted Poisson regression model. As part of the data restructuring and transforming processes, Propor_m and Propor_ns were respectively, computed as proportion of GP contacts with a male GP and with a non-specialist GP, based on the original integer values of the number of GP contacts with a male GP and with a non-specialist GP.

Before the regression model was fitted, descriptive analyses were conducted using histograms and percentiles to study the distribution of the data with emphasis on examination of outliers and extreme values. Outliers and extreme values were handled by winsorizing the values for dependent variable at 95 percentile of the sample which gave eight GP contacts as the maximum value of the dependent variable.

SPSS version 20 was used as it has a feature that supports the analysis of count data with non-normal distribution. The Generalized Linear Models was used to fit Poisson regression. When the model was tested to examine if the distribution of the data fits a Poisson model, there was a significant difference (Pearson chi-square, $p < 0.05$) implying possibility of overdispersion in the data.

Given this indication of overdispersion, negative binomial distribution was found to be the best alternative and thus a negative binomial model was fitted. However, there was no change in regression coefficients and significance level when a negative binomial model was fitted. An indication of overdispersion can be present in a Poisson distribution due to one or more factors, including omission of relevant variables from the model, the functional forms specified may be incorrect, or there may be dependence between the events that constitute each count (Berk and MacDonald, 2008). Family income, parents' education level, distance to health care centre and urban-rural differences were found to be variables that influenced access to and hence demand for health care (OECD, 2009; Berra et al, 2009; Vila et al, 2012). Since these variables were not included in the model, the significant variation ($p < 0.05$) observed in the test of goodness-of-fit of the Poisson model in the present study was likely to have resulted due to the omission of these variables and seems not to be a real overdispersion. Thus, I decided to use Poisson regression given the fact that negative binomial did not change the parameter estimates and the marginal effect of exemption on the number of GP contacts; refer appendices III and IV. The estimated marginal means for the exempted and payer groups were the same both in Poisson and negative binomial models. This means that the predicted probabilities of the number of GP contacts for the exempted and payer groups is the same when computed based on these two models.

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6 DESCRIPTIVE ANALYSIS AND RESULTS

6.1 Descriptive analysis

The number of patients from each birth cohort that was observed during each of the three observation years and their proportion to total sample has been presented in Table 4. The number of observations related to birth cohorts 1994 and 1996 constituted about 34.2% and 33.9% of the total sample. 31.9% of the observed patients were from cohort 1998. Furthermore, we see that the proportion of observations related to the three cohorts increased with observation years indicating that the number of adolescents that had at least one GP contact increased with time.

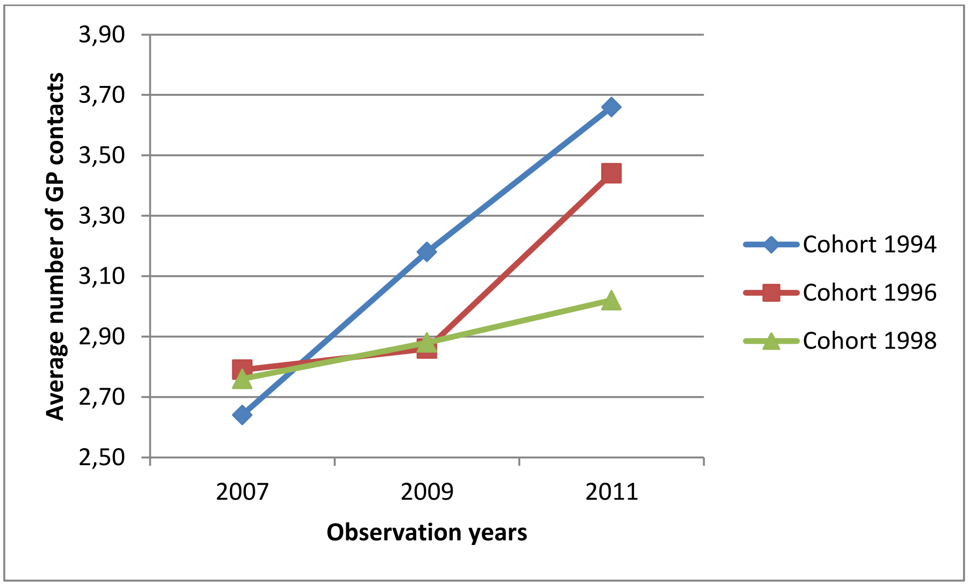
Table 4. Number of patients from a birth cohort across three observation years, their proportion relative to the total sample and mean number of GP contacts.

Cohort	No. of patients	Proportion %	Mean GP contacts
1994	122,396	34.2	
Observation year			
2007	34,411	9.6	2.64
2009	40,984	11.5	3.18
2011	47,001	13.1	3.66
1996	121,363	33.9	
2007	37,428	10.4	2.79
2009	39,004	10.9	2.86
2011	44,930	12.6	3.44
1998	113,966	31.9	
2007	35,877	10.0	2.76
2009	38,181	10.7	2.88
2011	39,908	11.2	3.02
Total sample	**357,724**	**100.0**	

Interestingly, mean GP contact was also increasing with time. Comparison among birth cohorts show that cohort 1994 had the largest mean GP contacts both in 2009 (3.18) and in 2011 (3.66). GP contacts of this birth cohort increased by 0.54 between 2007 and 2009, and by 0.48 between 2009 and 2011. In the case of birth cohort 1996, GP contacts increased by 0.58 between observation years 2009 and 2011. Comparatively speaking, this was the only increment for this cohort that can be considered large. The increase in GP contacts of cohort 1998 was only 0.12 between 2007 and 2009, and 0.14 between 2009 and 2011. Stated differently, it can be noted that the increase in GP contacts of birth cohort 1998 was less than one-third as compared to the increase observed among cohort 1994. The trend of an increase in GP contacts among adolescents is also demonstrated schematically in Figure 2.

Figure 2, below, shows an increasing trend in GP contacts of all birth cohorts studied. After the year 2007 patients from birth cohort 1994 had the highest number of GP contact on average and the schematic illustration in the Figure indicates a steep increment. Birth cohorts 1996 and 1998 had almost the same number of GP contacts during the first two observation years. However, in 2011, GP contacts of cohort 1996 diverged greatly from that of cohort 1998 and approached to GP contacts of cohort 1994. Generally the trend of increasing GP contacts with time imply that age of patients is an important explanatory variable.

*Figure 2. A trend of GP contacts by birth cohorts across the observation years.**



**'Cohort' in the figure indicates the year of birth of the adolescents with cohort 1994 being the oldest adolescents in the sample.*

Descriptive statistics related to patient characteristics have been presented in Table 5. Number of observations, mean GP contacts with 95% confidence interval, standard deviation and number of GP contacts corresponding to three quartiles of the sample has been shown. On average, girls had a larger number of GP contacts as compared to boys. However, no difference was seen when compared based on median GP contacts. Birth cohorts 1994 and 1998 had the largest and the smallest mean GP contacts, respectively. The confidence interval for mean GP contacts related to all patient characteristics are narrow indicating high precision of our estimate which could be attributed to the large sample size and low variability in GP contacts.

Comparison between the group exempted from co-payment and the group required to pay co-payment fee shows that the payer group had larger mean GP contacts even though median GP contacts of the two groups do not show difference. Birth cohort 1994 which was indicated to have the largest mean GP contacts in Table 4 had never been exempted from co-payment during the three observation years. This birth cohort seems to inflate mean GP contacts of the group not-exempted from co-payment as reported below in Table 5.

Table 5. Descriptive statistics by patient characteristics (N=357724).*

Patient characteristics	**N**	**Mean GP contacts**	**Std. dev.**	**95% Confidence interval**	**Percentiles**		
					25%	**Median**	**75%**
Boys	180,537	2.94	2.15	2.93 – 2.95	1	2	4
Girls	177,187	3.17	2.29	3.16 – 3.18	1	2	4
Exempted	196,324	3.00	2.18	2.99 – 3.01	1	2	4
Payer	161,400	3.13	2.22	3.11 – 3.14	1	2	4
Cohort 1994	122,396	3.21	2.31	3.20 – 3.22	1	2	5
Cohort 1996	121,362	3.05	2.22	3.04 – 3.06	1	2	5
Cohort 1998	113,966	2.89	2.12	2.88 – 2.91	1	2	5

**Data related to patients from three birth cohorts were polled to estimate mean GP visits per observation year.*

Table 6, below, shows the number of individuals from each age group that was observed; the proportion an age group constitutes of the total sample; mean GP contacts; and the number of GP contacts at 25th, 50th and 75th percentile of the sample. The 13 year-old adolescents constituted the largest proportion of the sample. Mean age of participants was 13.18 years. In this Table, it can be clearly seen that mean GP contacts is increasing with the age of the adolescents with the youngest group of participants having 2.76 as compared to 3.66 GP contacts among the oldest adolescents in the sample. It can also be noted that the increment becomes larger after the age of 13.

Linking the results in Table 6 to those shown in Table 5, we can notice that the mean GP contacts of 13 year-old and younger adolescents is below the mean GP contacts of both co-payment paying and exempted groups which may imply that older adolescents are the main contributors to mean GP contacts among both those exempted and not exempted adolescents. Median GP contact is also higher among the 15 and 17 year-old adolescents as compared to the younger counterparts. Likewise, the 15 and 17 year-old adolescents had five GP contacts at 75th percentile of the sample in contrast to only four contacts among the younger age groups. In relation to this, Appendix I presents the number of GP contacts at percentiles of high resolution for the three birth cohorts in different observation years. Especially in observation year 2011, the oldest adolescents had more GP contacts at lower percentiles of the cohort sub-sample.

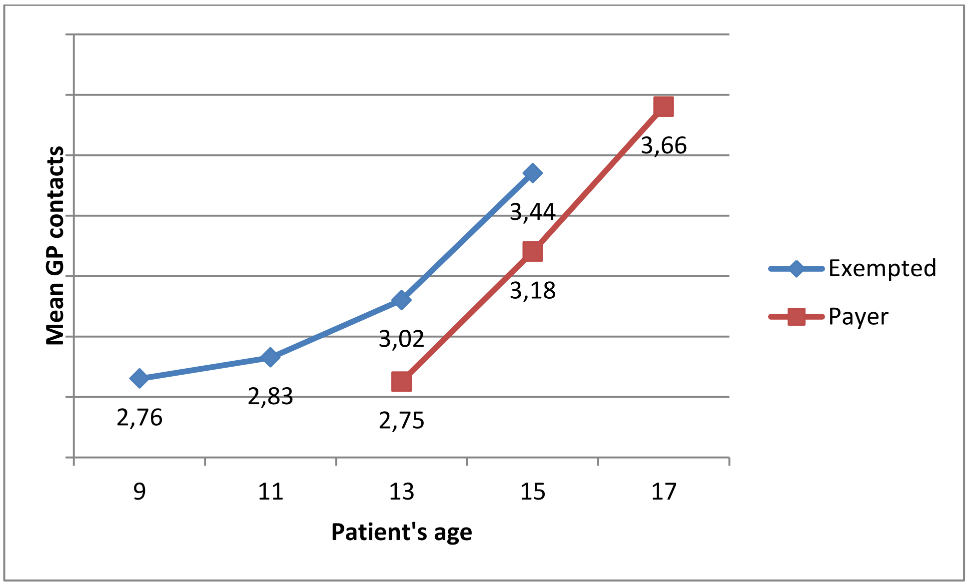
Table 6. Descriptive statistics by age (N=357724).*

Age	**No. of observations**	**Proportion of sample**	**Mean GP contacts**	**Std. dev.**	**Percentiles**			**Min**	**Max**
					25%	**Median**	**75%**		
9	35,877	10%	2.76	2.037	1	2	4	1	8
11	75,609	21%	2.83	2.086	1	2	4	1	8
13	113,323	32%	2.85	2.109	1	2	4	1	8
15	85,914	24%	3.32	2.337	1	3	5	1	8
17	47,001	13%	3.66	2.459	2	3	5	1	8

** Age was computed based on year of birth and the year during which the adolescent was observed. Adolescents from different birth cohorts can have the same age based on the year of observation.*

Figure 3 shows GP contacts of co-payment paying and exempted adolescents across various ages. The Figure indicates that only 13 and 15 year-old adolescents had experience as co-payment fee payers in one year and as exempted persons in another year. Thus, the comparison in this Figure may focus only on these two ages. The schematic presentation indicates that the 13 and 15 year-old patients exempted from co-payment had larger mean GP contacts as compared to the same-aged peers who were required to pay co-payment fee.

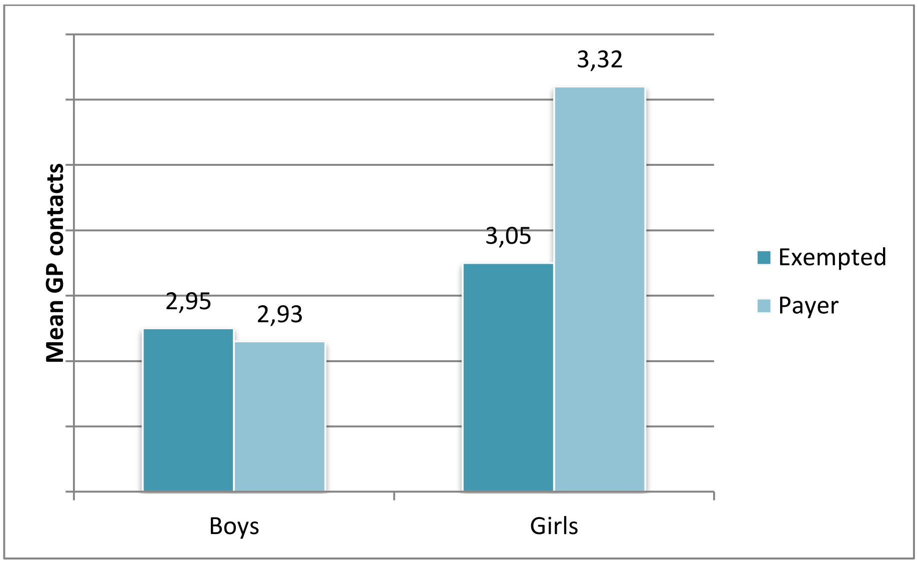
Figure 3. Comparison of GP contacts of co-payment fee payers and exempted adolescents across various ages.*



**In the sample, only 13 and 15 year-old adolescents had experience with co-payment and exemption from co-payment.*

Figure 4 shows a comparison of the average number of GP contacts of adolescents required to pay co-payment fee and those exempted adolescents of the same gender. The Figure shows that among boys, the exempted adolescents had more GP visits. In the case of girls, those subject to co-payment fee had substantially more GP contacts than the exempted counterparts. This could be due to the fact that medical conditions and diseases of women increase in adolescent girls with age and the girls in the cohort of the oldest adolescents in the sample had never been exempted from co-payment. Mean age of the exempted and co-payment fee paying girls was 12.0 and 14.8 years. When no distinction was made between payers and exempted groups, mean GP contact of girls and boys was 3.17 and 2.94 GP contacts, respectively. Both gender groups had 1, 2, and 4 GP contacts at the 25th, 50th, and 75th percentile of the sample. Boys and girls constituted 50.5% and 49.5% of the total sample, respectively.

*Figure 4. Gender specific comparison of GP contacts of co-payment fee payers and exempted adolescents.**



**The adolescents were from three birth cohorts. Mean age of the exempted and not-exempted adolescents was 11.9 and 14.7, respectively.*

6.2 Model results

In the descriptive analyses, in section 6.1, we saw that adolescents with such characteristics as older age, co-payment fee payers, girls, and those belonging to birth cohort 1994 had more GP contacts as compared to their counterparts in each of the descriptive comparisons. Regression model results have been presented in this section in order to get more accurate estimates by controlling the model for the explanatory variables presented in Section 5.2.2.

A Poisson regression model was used to estimate GP contacts among adolescents. Omnibus test of goodness-of-fit showed that the fitted model significantly outperformed the intercept model (likelihood ratio chi-sq. = 7743.3, df = 7, $p < 0.005$). No serious violation of assumptions for fitting Poisson regression was observed.

6.2.1 Estimated marginal means

Table 7 shows the model estimated marginal means, standard errors and confidence intervals for predictors of number of GP contacts at the factor levels of patient's gender, co-payment, and birth cohort. The estimated marginal means tell us the mean GP contact for each factor adjusted for variables in the model. Thus, the adjusted effects of the factors are presented.

Similar to the results in the descriptive statistics, the Table shows that girls had more GP contacts as compared to boys. However, contrary to the results in the descriptive statistics, the estimated marginal means show that the number of GP contacts was larger among the adolescents exempted from co-payment as compared to their counterparts who were not exempted.

Mean GP contacts for the predictor birth cohort ranged from a low of 2.99 for cohort 1994 to 3.10 for cohort 1998. This shows us that adjustment for other variables in the model changed mean GP contacts for cohort 1998 from being the smallest (2.89) as shown in Table 5 in the descriptive analysis to being the largest (3.10) as shown here in Table 7.

Table 7. Estimated marginal means at levels of variables used to predict GP contacts (N=357724).

Variable categories	Mean GP contacts	Std. error	95% CI Lower	95% CI Upper
Boys	2.93	0.005	2.92	2.94
Girls	3.14	0.005	3.13	3.15
Exempted	3.15	0.007	3.14	3.17
Payer	2.91	0.008	2.90	2.93
Cohort 1994	2.99	0.100	2.97	3.01
Cohort 1996	3.00	0.007	9.99	3.02
Cohort 1998	3.10	0.011	3.08	3.12

6.2.2 Adjusted effect of predictor variables

Regression coefficient, standard error and confidence interval for predictors of GP contacts have been presented below in Table 8. Adolescents exempted from co-payment had significantly ($p < 0.005$) more GP contacts as compared to those who paid co-payment fee [RRR: 1.082, 95% CI: (1.074 , 1.092)]. This means, in a year, GP contacts of those exempted from co-payment was estimated to be 8.2% higher than that of adolescents who were not eligible for exemption.

Comparison between gender groups showed that boys had significantly ($p < 0.005$) fewer number of GP contacts than girls [RRR: 0.932, 95% CI: (0.928 – 0.937)]. This indicates that the number of GP contacts among boys was 6.8% less compared to that of girls.

Compared with birth cohort 1998 (reference cohort), both of the other two cohorts had significantly less GP contacts ($p < 0.005$). Birth cohort 1994 [RRR: 0.964, 95% CI: (0.952 – 0.976)] and birth cohort 1996 [RRR: 0.969, 95% CI: (0.962 – 0.975)] had respectively, 3.6% and 3.1% less GP contacts as compared to birth cohort 1998.

Age of patients was also significantly ($p < 0.005$) associated with the number of GP contacts [RRR: 1.054, 95% CI: (1.052 – 1.055)]. This means each additional year of age in adolescence is associated with approximately 5.4% increase in GP contacts. A five year increase in the age of the patient who is of an adolescent age, is associated with a RRR of $(1.054)^5 = 1.30$. This is about a 30% increase in GP contacts for an adolescent who is five years older, other things being constant.

Both the proportion of contacts with a male GP ($p = 0.374$) and proportion of contacts with a non-specialist GP ($p = 0.274$) did not have statistically significant association with the number of GP contacts.

Table 8. Poisson regression for predictors of GP contacts of adolescents from three birth cohorts who were observed in 2007, 2009 and 2011 (N=357724).*

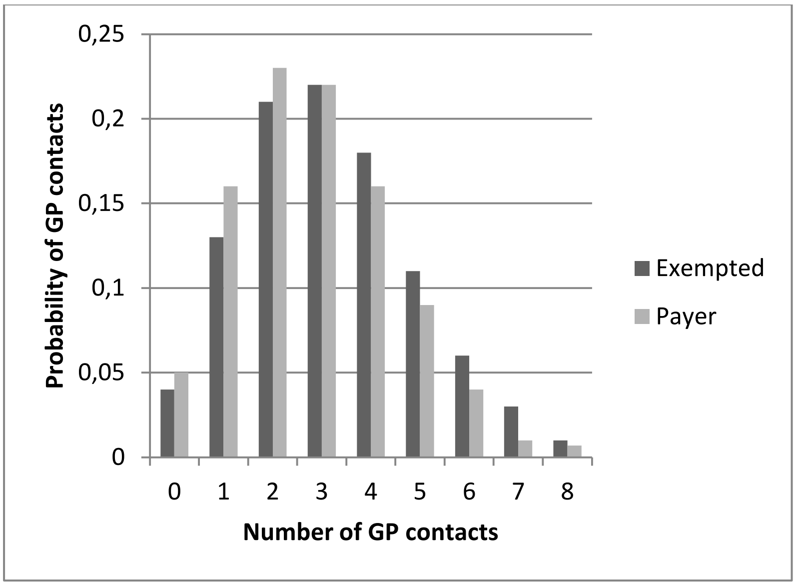
Predictor variable	**B**	**Std. error**	**95% Confidence interval**	
			Lower	**Upper**
Intercept	0.427	0.0099	0.407	0.446
Exempted	0.079	0.0045	0.071	0.088
Boy	-0.070	0.0024	-0.075	-0.065
Cohort 1994	-0.037	0.0064	-0.049	-0.024
Cohort 1996	-0.032	0.0037	-0.039	-0.025
Age	0.053	0.0007	0.051	0.054
Propor_m	0.003	0.0029	-0.003	0.008
Propor_ns	0.003	0.0027	-0.002	0.008

**Refer appendix II for more detailed version of Table 8.*

6.2.3 Prediction of probability of GP contacts in a year

The probability of making different number of GP contacts by patients has been predicted using the Poisson probability function. Figure 5 shows comparison of the probability of making different number of GP contacts by co-payment fee payers and exempted adolescents. In order to compute the probability distribution, I have used the estimated marginal means for the exempted and payer groups as λ values in the formula for Poisson probability function. These means are reported in Table 7, above.

Figure 5. Probability predicted by Poisson probability function for the number of GP contacts per year of the co-payment payers and exempted adolescents.*



**Adolescents from three birth cohorts with at least one GP contact in an observation year were included. Data was not available for adolescents with zero number of GP contacts.*

As it can be seen in Figure 5, the probability of making 0, 1, or 2 GP contacts was higher among co-payment fee payers than among the exempted adolescents. For example, the probability of making 2 GP contacts was 23% among the non-exempted and 21% among the exempted counterparts. However, the probability of making 3 GP contacts in a year was exactly the same among both the exempted and payer groups. Beyond 3 GP contacts, the exempted adolescents had higher probability of making a GP contact.

6.2.4 Predicted marginal increment in GP contacts

In this section we predict the marginal increment in GP contacts that is associated with exemption of adolescents from co-payment. The computation can be done by assuming different conditions for a patient based on the variables we have used in the regression model. Predicted GP contacts for the following patient conditions have been analyzed for illustration purposes.

Condition 1: A ***15*** year-old ***boy*** from ***birth cohort 1996*** who had been ***exempted*** from co-payment was considered in condition 1.

To obtain the predicted number of GP contacts, we take the anti-logarithm of the fitted log-linear model, which is the exponential function:

$$\text{GP contacts}_i = \exp(\textit{Intercept} + 0.079\,\boldsymbol{Exempted_i} - 0.07\,\textit{Boy}_i - 0.037\,\textit{Cohort1994}_i - 0.032\,\textit{Cohort1996}_i + 0.053\,\textit{Age}_i + 0.003\,\textit{Propor\_m}_i + 0.003\,\textit{Propor\_ns}_i)$$

$$= \exp(0.427 + 0.079\times\mathbf{1} - 0.070\times1 - 0.037\times0 - 0.032\times1 + 0.053\times15 + 0.003\times1 + 0.003\times1).$$

$$= \exp(1.205)$$

$= \mathbf{3.34}$ is the predicted number of GP contacts for the individual specified in condition 1.

Then we compare the predicted increase in GP contacts for the individual in condition 1 with a peer who is required to pay co-payment fee. All other things are the same as in condition one.

Condition 2: A ***15*** year-old ***boy*** from ***birth cohort 1996*** who had been ***required to pay*** co-payment fee.

$$\text{GP contacts} = \exp(\textit{Intercept} + 0.079\,\boldsymbol{Payer} - 0.07\,\textit{Boy} - 0.037\,\textit{Cohort1994} - 0.032\,\textit{Cohort1996} + 0.053\,\textit{Age} + 0.003\,\textit{Propor\_m} + 0.003\,\textit{Propor\_ns})$$

$$= \exp(0.427 + 0.079\times\mathbf{0} - 0.070\times1 - 0.037\times0 - 0.032\times1 + 0.053\times15 + 0.003\times1 + 0.003\times1)$$

= exp(1.126)

= **3.08** is the predicted number of GP contacts for the individual specified in condition 2.

The difference of 0.26 (3.34 – 3.08) GP contacts per year is the increase in GP contacts associated with exemption from co-payment. This means that the average number of GP contacts of adolescents exempted from co-payment is estimated to increase by 0.26 per year.

7 DISCUSSION

There seems to be scarcity of evidence about the association between a change in co-payment and the demand for GP services among 9-15 year-old adolescents in the Scandinavian region generally and in Norway specifically.

The extent of change in the number of GP contacts that is associated with the change in co-payment fee has been examined in the present study. The findings are, therefore, intended to fill the existing knowledge gap about the aforementioned association.

Discussion of findings

Three hypotheses were specified at the outset of the study. The first hypothesis states that exemption from co-payment that is considered to have no more than moderate financial burden is associated with an increase in health care consumption. By controlling the model for patient's gender, birth cohort, age, proportion of contacts with a male GP and proportion of contacts with a non-specialist GP, it has been found that exemption from co-payment is significantly ($p < 0.005$) associated with an increase in GP contacts among adolescents [RRR: 1.082, 95% CI: (1.074 , 1.092)]. The marginal effect of exemption is on average 0.26 GP contacts per year. This shows that adolescents who face zero monetary cost at the time of GP contact increase their number of contacts by 0.26 per year compared to their peers who pay co-payment fee. Thus, the first hypothesis in the study has been supported with the findings. In agreement with the present findings, a study from Ireland has previously found that the poor and unemployed people, who were exempted from co-payment, had 0.33 more GP visits as compared to those who were not entitled to free health care service; this increase of 0.33 was considered to be large (Nolan, 2007). Thus, the marginal effect found in the present study may be considered to be of moderate change.

The marginal effect in the present study is equivalent to an 8.2% increase in the number of GP contacts associated with a change of an adolescent from being required to share cost to being eligible to free health care. In Norway, out-of-pocket payments accounted for 37% of total costs (Lindahl and Squires, 2011). This out-of-pocket payment has the effect of a price on the demand for health care. Full exemption from cost-sharing indicates, therefore, a 100% reduction of the cost borne by the service users, which is associated with about 8.2% increase in GP contacts. In his German study of an indirect effect on GP visits of an increase in co-payment for prescription drugs, Winkelmann (2004) found a reduction in visits by 10% in response to an increase in co-payment for prescription drugs by up to 200%.

In addition to the findings of the present study discussed above, the results from the Poisson probability distribution (Figure 5) shows more clearly the significance of the change in co-payment in influencing the number of GP contacts. The probability of making 0, 1, or 2 GP contacts was higher among the co-payment fee payers as compared to the exempted group. However, beyond the average number of GP contacts, which is about 3 GP contacts, the probability of making 4 or more GP contacts was higher among the exempted adolescents. Adolescents who had four or more contacts with a primary health care physician were referred to as frequent health care attenders (Vila et al, 2012). Taking this designation into the present study, we can note that the probability of being a frequent health care attender is higher among the exempted adolescents. Since the aim of the present study was not to investigate whether or not exemption from co-payment leads to excessive consumption of health care among adolescents, at this point, we do not know if the increased frequency of GP contacts indicates overconsumption of health care. However, we can give due consideration to the generally acceptable viewpoint that cost-sharing arrangements leads to a reduction in unnecessary use of health care and to instil an appreciation by health care users of the true value of health care provided free at point of use (Folland et al, 2013).

Although an increase of 0.26 GP contacts, as found in the present study, is not large relative to the average number of GP contacts (3.06), it indicates that exemption from co-payment has been perceived by the adolescents and their families to have some significance in removing financial burden related to health care consumption. If co-payment fees are perceived by patients to be too small to have effect on total household consumption, exemption thereof is not expected to increase health care consumption. When a change in co-payment is considered substantial, it has an effect of a price on health care consumption (Folland et al, 2007). In 2009 the burden of out-of-pocket payment, which is conventionally measured as a share of total household income or by its share of total household consumption, constituted 3.4% as a share of final household consumption in Norway. This was slightly higher than the average for OECD countries which was 3.2% (OECD, 2011). Is this financial burden significant enough to deter access to health care in Norway? It seems we have an answer to this questions from a study done 20 years ago: “[t]he relatively low fees, together with the limit on expenses (in the form of deductibles) for consultations in Norway and Sweden, are probably not something that make people abstain from seeking care" (Holm et al, 1990, p. 324). Furthermore, it is worthwhile to note the findings of previous Norwegian studies that investigated association between family income and health care consumption among adolescents. A study of health-care-seeking behaviours of 15-16 year-old, 10th grade students in Oslo have found that there was no association between adolescents' health care utilisation and the family's economic situation or a parent's unemployment (Haavet et al, 2005). However, the present study shows, even in a country like Norway where the burden of cost-sharing is generally understood to be not substantial, statistically significant association has been found between exemption from co-payment and better access to primary health care provided by GPs.

The second hypothesis in the present study states that adolescents' consumption of health care increases with their age. Descriptive analysis (Table 6) shows the number of GP contacts ranges on average from as low as 2.76 among nine-year-olds to as high as 3.66 GP contacts among 17 year-old adolescents. Having a close examination of the figures in the Table, one can notice the increase in the number of GP contacts was small up to the age of 13. Comparatively speaking, the increase becomes larger starting from the age of 15.

When the regression model was adjusted for potential confounders, age in adolescence was found to have significant ($p < 0.005$) association with the number of GP contacts [RRR: 1.054, 95% CI: (1.052 – 1.055)]. Health care consumption during adolescence increases with age. An increase of one year in the age of an adolescent is associated with a 5.4% increase in the number of GP contacts giving on average a marginal effect of 0.18 GP contacts per one additional year. Thus, the second hypothesis has been supported. From previous studies age was generally found to be a determinant of health care consumption with small children and older people consuming more health care service than the rest of the population (Scott, 2000).

The third hypothesis states that raising the age limit for exemption of older adolescents enables them to have their increased need for health care met. Age-specific comparison of GP contacts by co-payment fee payers and exempted adolescents showed more health care consumption among adolescents entitled to free health care both at the age of 13 and 15 (Figure 3). The difference between average number of GP contacts of exempted and co-payment paying adolescents of the same age was about 0.27 contacts per year.

Thus, the results from the age-specific comparison of GP contacts of the co-payment fee paying and exempted adolescents, and the relatively large increase in health care consumption especially after the age of 13, uncover one noteworthy finding; that is, as health care needs of adolescents increase with their transition to middle adolescence, eligibility to free health care provide them with better access to health care. This finding supports the third hypothesis. It indicates that as adolescents' need for health care increases with age, exemption from co-payment creates a more favourable health care environment for adolescents as it enables them to become practical users of health service. Based on the fact that age remained to be significant determinant of health care demand even after controlling for eligibility for free medical care and health status, Nolan (2007) has indicated the possibility of greater awareness of good health as age increases. This implies that exemption from co-payment enables to reduce forgone health care among older adolescents by reducing financial barrier to access. A previous study of foregone health care among adolescents from the USA has found older age in adolescence to be associated with increased risk of foregone health care; the older the adolescent the greater is the risk of foregone health care (Ford et al, 1999).

Our study also finds association between gender and health care consumption among adolescents where boys have significantly ($p < 0.005$) smaller number of GP contacts than girls (RRR = 0.932, 95% CI: 0.928 – 0.937). This denotes that boys consume GP services 6.8% less than that of girls' consumption. In other words, the increase in health care consumption associated with being a girl has been found to be 0.24 GP contacts. A previous study of the influence of socioeconomic variables on the demand for primary health care in the Netherlands, also found that the influence of sex was large and significant with women being more frequent physician consulters than men (van der Gaag and van de Van, 1978). Even though the population in their study were mostly adults, the findings from the previous study and from our study show that the differential effect of gender is similar in older and younger age populations.

The present study has not found significant association between health care consumption and GP's sex. This finding is consistent with findings from a previous study (Hetlevik et al, 2010). Furthermore, whether or not a GP was a specialist in general practice does not have association with the number of GP contacts among adolescents.

Strengths and limitations

Given the relevance of the variables considered in determining health care demand, and the consistency of the study results with previously published findings of association between exemption from co-payment and increased health care consumption, I reassert that the findings of the present study represent the real-life associations of the variables examined. The results of association between exemption from co-payment and increased number of GP contacts coincide with the theory of price elasticity of demand, which has been used as the theoretical framework in the present study. Furthermore, there is little possibility of under- or over-reporting and no missing values in the selected variables. The register-based cohort study has enabled to avoid problems related to selection bias; thus a reasonable level of validity of results. I could not see problematic measurement errors that seriously reduce the reliability of the data register used for the study.

However, the investigated associations could have been better explained if additional variables had been controlled for as potential confounders in the present study. Travelling distance and physician density are among several variables that determine access to and consumption of health care service (OECD, 2011). Due to time constraints, the data file used in the present study was not linked with related data sources that were found under the ownership of organizations other than the Norwegian Directorate of Health.

Another limitation in the study was the inability to link the data file that consists of only those who had at least one GP contact, with a data file that consists of members of the same birth cohort who had zero contact with a GP in an observation year. The inclusion of adolescents who had zero GP contacts would have enabled us to provide more comprehensive information about GP contacts. Most of the limitations in the present study are mainly related to time constraints.

Policy implications

Given the strengths of the study, the findings can be generalized to populations with similar demographic and socio-economic contexts. Although the marginal increment in the number of GP contacts was not large, it can be generalized that there is statistically significant association between exemption from co-payment and increased health care consumption among adolescents. The association of exemption with increased consumption of health care has implications for two important policy issues: efficiency and equity in the provision of health care service.

The trade-off between efficiency and equity is an important issue in health care policy. Through its impact on allocation of resources and services, exemption from cost-sharing increases both inefficiency and equity in an economy. As illustrated in Section 4.2.3, exemption reduces allocation efficiency by increasing the loss in well-being. The loss in well-being is higher in a situation where there is exemption from cost-sharing than in a situation where service users are required to pay a co-payment fee. Loss in well-being results because the marginal cost of consuming a subsidized health care service is greater than the marginal benefit enjoyed by the consumer. This means that even though both co-payment and exemption cases result in loss in well-being, the loss is larger in the latter case. Allocative efficiency is reduced when the incremental cost is greater than the incremental benefit. Allocative efficiency refers to the situation in which resources are put to their best possible uses in the economy so that no further gains in output or welfare are possible (Folland et al, 2013). The fully subsidised service, as in the case of exemption, causes distortion in the allocation of resources making it difficult to achieve policy objective of efficiency.

The indirect effect of removal of co-payment on adolescents' demand for health care provided by school nurses and health stations is also a policy-relevant issue. GP services are thought to be more costly than the same type of services provided by a school nurse or by a health station at least due to the difference in labour cost of the service provided. However, exemption of adolescents may lead to a shift from consumption of services provided by a school nurse or a health station to GP services even though the service sought is still provided by the first two less costly primary health care providers. This reduces cost efficiency. According to Olsen (2009), cost efficiency refers to the ability to provide the same level of services with the cheapest possible combination of resources. The provision of free GP services implies that there is possibility for the third party payer to pay more for the same type of service. Furthermore, exemption from co-payment leads to more public health spending and hence less efficiency especially if the exempted consumers tend to over-utilise health care because of their eligibility to subsidised service (Folland et al, 2013). As a policy issue, the public spending implication of exemption needs to be considered in light of the benefits the society obtains from exemption.

As a benefit, exemption enables a health care system to ensure equitable distribution of health care to vulnerable social groups by removing financial barriers to access. Equity means fairness in the distribution of health care or ensuring equal access to people with equal needs for health care (Olsen, 2009). The fully subsidised GP services improve access to health care especially for people with less ability to pay for it. This means that exemption supports users to get appropriate and timely primary health care in general and preventative services in particular. Zweifel and Manning (2000) have noted that the consumption of preventative health care services decline with increasing out-of-pocket money price, and preventative care is more responsive to price than is the demand for other medical services. Through its influence for equitable distribution of health care, exemption responds to the needs of socio-economic groups that would delay or forgo needed health care due to financial difficulties (OECD, 2011). Since adolescents are dependent on their parents for financial resource, their willingness to visit a health care provider may be constrained by the lack of their own financial resource, especially if they do not want their parents to know about their contact with a GP in general and their sickness in particular.

The findings of the present study show that the number of GP contacts increase with age in adolescence and the oldest adolescents ever exempted (15 year-olds) had more GP contacts than their same-aged peers who were required to pay co-payment fee. Thus, I suggest for revision of the existing policy on exemption in order to raise further the age threshold for co-payment with the intention of exempting adolescents who are older than 15 years of age. Such a revision strengthens the adolescent-friendliness of the Norwegian health care system and supports the use of adolescent health as opportunity to sustain health. However, as the present study provides only partial information for decision-making, revisions may be considered in relation to efficiency considerations.

8 CONCLUSION

To my knowledge, this is the first study of association between exemption from co-payment and adolescents’ primary health care consumption in Norway. Since there has been scarcity of context relevant information of such association, the findings of the present study are expected to fill the knowledge gap about this association in a Scandinavian context. Information produced from this study may have significance for allocative efficiency as the study findings reflect the preference of health care consumers in relation to exemption from co-payment.

In agreement with the claim made, the study finds a significant association between exemption of adolescents from co-payment and increased consumption of primary health care service provided by GPs. The statistically significant increase in the number of GP contacts indicates that in a health care market characterized by elastic demand, adolescents and their parents are responsive to a moderate or smaller change to service price. When we interpret this finding it may be said that exemption from co-payment is one of the main factors that contribute to adolescent friendly health care service. Starting from the lowest age limit in adolescence, primary health care consumption increases with age indicating that health care needs increases with age among adolescents. This was found among both the exempted and co-payment fee paying adolescents. The fact that 13 and 15 year-old adolescents who were eligible for fully subsidized GP services had more contacts than same-aged co-payment fee payers, has a policy implication for raising the age threshold further to exempt older adolescents. This can make the health care system more adolescent-friendly with a patient payment policy that strengthens the capacity of the health care system to meet contemporary challenges of adolescent health.

It is also worth noting that girls in their adolescence ages consume more primary health care than boys indicating that gender effect in health care consumption is present not only among adults but also among young people.

Based on the present study, I suggest three areas for future research. Firstly, various health benefits may be expected as a result of exemption from health care. Thus, future research should focus on investigating association between exemption from co-payment and health benefits for adolescents. Secondly, the demand for health care services provided by school nurses and health stations might have decreased due to adolescents’ eligibility to free GP services. It is, therefore, important to study the indirect effect of exemption from cost-sharing on adolescents' demand for primary health care provided by school nurses and health stations. Thirdly, since one of the limitations of the present study was my inability to include additional relevant variables, I suggest for more research in order to examine the question of the present study by including additional relevant variables and by employing panel data analysis models.

Reference

BARROS, P. P. and MARTINEZ-GIRALT, X. (2012) *Health economics: an industrial organization perspective*. London: Routledge.

BERK, R. and MACDONALD, M. (2008) Overdispersion and Poisson regression. *Journal of Quantitative Criminology*. 24. p. 269-284.

BERRA, S. et al (2009) Correlates of use of health care services by children and adolescents from 11 European countries. *Medical Care*. 47 (2). p.161-167.

BORNSTEIN, B. H. MARCUS, D. and CASSIDY, W. (2000) Choosing a doctor: an exploratory study of factors influencing patients' choice of primary care doctor. *Journal of Evaluation in Clinical Practice.* 6 (3). p.255-262.

BRITTO, M. T. et al (2001) Impact of a school-based intervention on access to health care for underserved youth. *Journal of Adolescent Health*. 29. p.116-124.

CAPPELEN, I. (2012) Bruk av data fra primærhelsetjenesten og fra legerefusjonsordningen-HELFO/KUHR/ The use of data from primary health care and from physician reimbursement scheme. Kvalitetsregisterkonferansen 19 April 2012. Available from: http://helseregistre.no/getfile.php/Norsk/Registerkonferanse%202012/Presentasjoner/07%20Cappelen.pdf [Accessed on 26/03/2013].

EPSTEIN, R. RICE, P. and WALLACE, P. (1989) Teenagers' health concerns: implications for primary health care professionals. *Journal of Royal College of General Practitioners*. 39. p.247-249.

FOLLAND, S. GOODMAN, A.C. and STANO M. (2013) *The economics of health care: international edition*. 7th Ed. New Jersey: Pearson.

FOLLAND, S. GOODMAN, A.C. and STANO M. (2007) *The economics of health care: international edition.* 5th Ed. New Jersey: Pearson.

GLEESON, C. R. ROBINSON, M. B. and NEAL, R. D. (2002) A review of teenagers' perceived needs and access to primary health care: implications for health services. *Primary Health Care Research and Development*. 3 (3). p.184-193.

HELFO (2013) Egenandeler for helsetjenester/ Co-payment fees for health care. Available from: http://www.helfo.no/privatperson/egenandeler/sider/default.aspx. [Accessed on 20/01/2013].

HETLEVIK, Ø. HAUG, K. and GJESDAL, S. (2010) Young people and their GP: a register-based study of 1717 Norwegian GPs. *Family Practice*. 27. p.3-8.

HILL, R. C. GRIFFITHS, W. E. and LIM, G. C. (2012) *Principles of econometrics: international student version.* 4th Ed. New Jersey: John Wiley & Sons.

HOLM, S. LISS, P. and NORHEIM, O. F. (1990) Access to health care in Scandinavian countries: ethical aspects. Health Care Analysis. 7. p. 321-330.

IVERSEN, T. and LURÅS, H. (2008) Patient switching in a list patient system. *HERO Working Paper 2008*. 4.

KEELER, E. B. (1992) Effects of cost sharing on use of medical services and health. *RAND Corporation, Health Policy Program*. p.317-321. Available from: www.rand.org. [Accessed on 01/03/2013].

KLEINERT, S. (2007) Adolescent health: an opportunity not to be missed. *The Lancet,* 369. p.1057-1058.

LEIBOWITZ, A. et al (1985) Effect of cost-sharing on the use of medical services by children: interim results from a randomized controlled trial. *Pediatrics*. 75 (5). p. 942-951.

LUCAS, P. et al (2012) Financial benefits for child health and well-being in low income or socially disadvantaged families in developed world countries. *The Cochrane Collaboration*.

LINDAHL, A. K. and SQUIRES, D. (2011) The Norwegian health care system. In Thomson, S. et al (eds). *International profiles of health care systems, 2011*. The Common Wealth Fund. Available from: http//www.commonwealthfund.org/ [Accessed on 18/02/2013].

NEWBOLD, P. CARLSON, W. L. and THORNE, B. (2010) *Statistics for business and economics.* 7th Ed. New Jersey: Pearson.

NOLAN, A. (2007) A dynamic analysis for GP visiting in Ireland: 1995-2001. *Health Economics*. 16. p.129-143.

OECD (2011) *Health at a glance 2011: OECD indicators*. Paris: Organization for Economics Cooperation and Development.

OECD (2009) *Health at a glance 2009: OECD indicators*. Paris: Organisation for Economic Cooperation and Development.

OLSEN, J. A. (2009) *Principles in health economics and policy*. Oxford: Oxford University Press.

ONLINELEGE (2011) Hvor mye kan fastlegen ta betalt for timen?/ How much does a GP charge for consultation? Available from: http://www.onlinelege.no [Accessed on 15/02/2013].

POTTS, Y. GILLIES, M. L. and WOOD, S. F. (2001) Lack of mental wellbeing in 15-year-olds: an undiscovered iceberg? *Family Practice*, 18. p.95-100.

ROBINSON, R. (2002) User charges for health care. In Mossialos, E. et al (eds). *Funding health care: options for Europe*. Buckingham, Philadelphia: Open University Press.

RUBIN, R. and MENDELSON, D. (1995) A framework for cost-sharing policy analysis. In Mattison (ed.) *Sharing the costs of health: a multi-country perspective*. Basle: Pharmaceutical Partners for Better Health.

SCOTT, A (2000) Economics of general practice. In Culyer, A. J. & Newhouse, J. P. (eds.). *Handbook of Health Economics*. Available from: http://www.sciencedirect.com/ [Accessed on 20/02/2013].

STARFIELD, B. (1994) Is primary care essential? *The Lancet*. 344. p.1129-1133.

TYLEE, A. et al (2007) Youth-friendly primary care services: how are we doing and what more needs to be done? *The Lancet*. 369. p.1565-1573.

VAN DER GAAG, J. and VAN DE VEN, W. (1978) The demand for health primary health care. *Medical Care*. 16 (4). p. 299-312.

VILA, M. et al (2012) Adolescents who are frequent attenders to primary care: contribution of psychosocial factors. *Social Psychiatry and Psychiatric Epidemiology*. 47. p. 323-329.

WINKELMANN, R. (2004) Co-payments for prescription drugs and the demand for doctor visits: evidence from a natural experiment. *Health Economics*, 13. p.1081-1089.

ZIMMER-GEMBECK, M. J. ALEXANDER, T. and NYSTROM, R. J. (1997) Adolescents report their need for and use of health care services. *Journal of Adolescent Health*. 21.p.388-399.

ZWEIFEL, P. and MANNING, W. (2000) Moral hazard and consumer incentives in health care. In *Handbook of Health Economics*. Culyer, A. J. & Newhouse, J. P. (eds).

Appendix

Appendix I. Number of GP contacts in an observation year at different percentile of a birth cohort.

	Observation year 2007			**Observation year 2009**			**Observation year 2011**		
	Cohort			**Cohort**			**Cohort**		
Percentile	**'94**	**'96**	**'98**	**'94**	**'96**	**'98**	**'94**	**'96**	**'98**
5	1	1	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1	1	1
15	1	1	1	1	1	1	1	1	1
20	1	1	1	1	1	1	1	1	1
25	1	1	1	1	1	1	2	1	1
30	1	1	1	1	1	1	2	2	1
35	1	1	1	2	1	2	2	2	2
40	2	2	2	2	2	2	2	2	2
45	2	2	2	2	2	2	3	2	2
50	2	2	2	2	2	2	3	3	2
55	2	2	2	3	2	2	3	3	3
60	2	3	3	3	3	3	4	3	3
65	3	3	3	3	3	3	4	4	3
70	3	3	3	4	3	3	5	4	4
75	3	4	4	4	4	4	5	5	4
80	4	4	4	5	4	4	6	6	5
85	5	5	5	6	5	5	7	7	6
90	6	6	6	7	6	6	8	8	7
95	8	8	8	8	8	8	8	8	8
N =	34411	37428	35877	40984	39004	38181	47001	44930	39908

Appendix II. Poisson regression parameter estimates and exp(B) with 95% confidence interval.

Predictor variable	B	Std. error	95% Confidence interval		Hypothesis test			Exp(B)	95% CI for Exp(B)	
			Lower	Upper	Wald Chi-sq.	df	Sig.		Lower	Upper
Intercept	0.427	0.0099	0.407	0.446	1845.1	1	0.005	1.532	1.503	1.562
Exempted = 1	0.079	0.0045	0.071	0.088	310.3	1	0.005	1.083	1.073	1.092
Payer = 0	0[a]	.	.	.	.	.	.	1.0	.	.
Boy = 1	-0.070	0.0024	-0.075	-0.065	847.5	1	0.005	0.932	0.928	0.937
Girl = 0	0[a]	.	.	.	.	.	.	1.0	.	.
Cohort1994 = 1[b]	-0.037	0.0064	-0.049	-0.024	33.4	1	0.005	0.964	0.952	0.976
Cohort1996 = 1[b]	-0.032	0.0037	-0.039	-0.025	74.4	1	0.005	0.969	0.962	0.976
Cohort1998 = 0	0[a]	.	.	.	.	.	.	1.0	.	.
Age	0.053	0.0007	0.051	0.054	5062.6	1	0.005	1.054	1.053	1.056
Propor_m	0.003	0.0029	-0.003	0.008	0.8	1	0.374	1.003	0.997	1.008
Propor_ns	0.003	0.0027	-0.002	0.008	1.2	1	0.274	1.003	0.998	1.008

[a]Set to zero because this is the reference parameter.

[b]When one of these two variables takes the value of 1, the other one takes 0.

Appendix III. Negative binomial regression parameter estimates and exp(B) with 95% confidence interval.

Predictor variable	B	Std. error	95% Confidence interval		Hypothesis test		
			Lower	Upper	Wald Chi-sq.	df	Sig.
Intercept	0.432	0.0100	0.412	0.451	1882.5	1	0.005
Exempted = 1	0.079	0.0045	0.070	0.088	312.6	1	0.005
Payer = 0	0a	.	.	.	.	.	.
Boy = 1	-0.067	0.0024	-0.072	-0.063	781.5	1	0.005
Girl = 0	0[a]	.	.	.	.	.	.
Cohort1994 = 1[b]	-0.039	0.0063	-0.051	-0.026	37.3	1	0.005
Cohort1996 = 1[b]	-0.033	0.0037	-0.040	-0.025	78.4	1	0.005
Cohort1998 = 0	0[a]	.	.	.	.	.	.
Age	0.052	0.0007	0.051	0.054	4983.7	1	0.005
Propor_m	0.003	0.0030	-0.003	0.009	1.1	1	0.291
Propor_ns	0.003	0.0028	-0.002	0.009	1.2	1	0.275

[a]Set to zero because this is the reference parameter.

[b]When one of these two variables takes the value of 1, the other one takes 0.

Appendix IV. Predicted number of GP contacts using negative binomial regression coefficients.

Condition 1: A ***15*** year-old ***boy*** from ***birth cohort 1996*** who had been ***exempted*** from co-payment was considered in condition 1.

GP contacts = exp(*Intercept* + 0.079 ***Exempted*** – 0.067 *Boy* – 0.039 *Cohort1994* –

0.033 *Cohort1996* + 0.052 *Age* + 0.003 *Propor_m* + 0.003 *Propor_ns*)

= exp(0.432 + 0.079×**1** – 0.067×1 – 0.039×0 – 0.033×1 + 0.052×15

+ 0.003×1 + 0.003×1).

= exp(1.197)

= **3.32** is the predicted number of GP contacts for the individual

specified in condition 1.

Then we compare the predicted increase in GP contacts for the individual in condition 1 with a peer who is required to pay co-payment fee. All other things are the same as in condition one.

Condition 2: A ***15*** year-old ***boy*** from ***birth cohort 1996*** who had been ***required to pay*** co-payment fee.

GP contacts = exp(*Intercept* + 0.079 ***Payer*** – 0.067 *Boy* – 0.039 *Cohort1994* –

0.033 *Cohort1996* + 0.052 *Age* + 0.003 *Propor_m* + 0.003 *Propor_ns*)

= exp(0.432 + 0.079×**0** – 0.067×1 – 0.039×0 – 0.033×1 + 0.052×15

+ 0.003×1 + 0.003×1).

= exp(1.118)

= **3.06** is the predicted number of GP contacts for the individual

The marginal effect = 3.32-3.06 = 0.26. It did not change when negative binomial was used. The predicted values were also very small.