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Paediatric primary care during public health crises: Protocol of the mixed-methods COVID-19 PedCare Study

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ABSTRACT

Introduction

Public health crises such as pandemics can cause serious disruptions to the utilisation and provision of healthcare services with negative effects on morbidity and mortality. Despite the important role of paediatric primary care in maintaining high-quality healthcare services during crises, evidence about service utilisation and provision remains limited. This study therefore explores the utilisation and provision of paediatric primary care services during the ongoing COVID-19 pandemic as well as their barriers and facilitators.

Methods and analysis

The study uses a convergent mixed-methods design and comprises online surveys to parents, adolescents and primary care paediatricians (PCPs) and semistructured interviews with parents and PCPs. We recruit parents and adolescents from paediatric primary care practices and PCPs via mailing lists of the German Professional Association of Paediatricians as well as the German Society of Ambulatory Primary Care Paediatrics. The parent and adolescent surveys assess, inter alia, the utilisation of paediatric primary care services and its correlates, aspects of parental and child health as well as socioeconomic characteristics. The PCP survey examines the provision of paediatric primary care services and its correlates, aspects of PCP health as well as sociodemographic and practice characteristics. The semistructured interviews with parents and PCPs explore several aspects of the online surveys in more detail. We use descriptive statistics and generalised linear mixed models to assess service utilisation and provision and specific correlates covered in the online surveys and apply qualitative content analysis to explore barriers and facilitators of service utilisation and provision more broadly in the semistructured interviews. We will integrate findings from the quantitative and qualitative analyses at the interpretation stage.

Ethics and Dissemination

The study was approved by the Medical Ethics Review Board of the Medical Faculty Mannheim at Heidelberg University (2020-650N). Study results will be published in journals with external peer-review.

Keywords

COVID-19, paediatrics, organisation of health services, quality in health care

Strengths and limitations of the study

- The current study is among the first to comprehensively explore the utilisation and provision of paediatric primary care services as well as their barriers and facilitators during a major public health crisis.
- Using a convergent mixed-methods design we explore the perspectives of parents, adolescents and primary care paediatricians.
- We only cover families consulting their primary care paediatricians during the pandemic.
- We are not able to attribute findings to particular phases of the pandemic such as lockdown or inter-lockdown periods.

INTRODUCTION

Public health crises such as pandemics can cause severe disruptions to both the provision of paediatric healthcare services and their utilisation.[1, 2] Both provision and utilisation of services should be considered to fully understand the impact of crises on healthcare systems and to identify strategies to strengthen their resilience because high-quality care might be compromised by disruptions to service provision, decreased service utilisation or a combination of both.

The extent to which the utilisation and provision of paediatric healthcare services is affected by public health crises is not fully understood. Substantial changes in the utilisation of paediatric emergency care were observed during past epidemics.[1-3] Early evidence on the ongoing coronavirus disease 2019 (COVID-19) pandemic and its concomitant lockdown and social distancing measures suggests declines in the utilisation of paediatric healthcare services including paediatric emergency care,[4] services for children with special healthcare needs such as occupational therapy or physiotherapy [5] and vaccinations.[6-9] Service provision during the COVID-19 pandemic has been compromised by cancellations or deferrals of elective or non-emergency surgeries and by temporary closures of paediatric oncology departments.[10-12]

Reduced utilisation of paediatric healthcare services and disruptions to service provision during public health crises can contribute to higher morbidity and mortality. An increased proportion of severe ketoacidosis in children and adolescents newly diagnosed with type 1 diabetes and more complications in young people with acute appendicitis during the COVID-19 pandemic, compared to the prepandemic period, were most likely caused by delayed presentation.[13-15] It is expected that the deferral of chronic care during the pandemic will be accompanied by increased morbidity and mortality in the future.[16]

Paralleling the role of general medicine for adult patients, paediatric primary care plays an important role in responding to disruptions to service utilisation and provision during public health crises.[17] Several countries in Europe and globally have paediatrician-based (e.g., Spain, Czech Republic, USA) systems or ones in which both general practitioners, family doctors and paediatricians provide paediatric primary care (e.g., Austria, France, Germany).[18, 19] In countries with paediatrician-based and combined systems, primary care paediatricians (PCPs) are the first point of contact with the healthcare system for most children and adolescents, providing acute, chronic and preventive care, counselling as well as coordination of services with community-based service providers.

Paediatric primary care has the potential to contribute to high-quality healthcare services during public health crises due to its role in disease surveillance, the provision of accessible and equitable

services in light of protracted emergencies and its potential to reduce non-emergency-related morbidity and mortality.[17] Minimising disruptions to service utilisation and provision in paediatric primary care should therefore be a priority. To our knowledge, however, only one study has examined utilisation of paediatric primary care services during the COVID-19 pandemic, reporting declines in in-person-consultations ranging from 40% to more than 80% between March and August 2020 compared to previous years.[20]

Reasons for reduced utilisation of paediatric healthcare services during pandemics are not well understood. Potential explanations may include parental fear of infection,[21, 22] pending mandatory SARS-CoV-2-test results [21] or disruptions to service provision due to closed healthcare facilities, staff shortages [23] or changes in practice opening hours.[24] Given its central role within the healthcare system especially during public health crises, studies comprehensively assessing the scope of disruptions to paediatric primary care service utilisation and provision, their associated factors and leverage points to strengthen paediatric primary care in times of crises are urgently needed.

Socioeconomic factors may introduce additional forces that affect service utilisation during public health crises differentially, aggravating existing health inequalities.[25, 26] During past epidemics, for example, health outcome indicators such as morbidity and mortality rates differed by socioeconomic characteristics at multiple levels: Individuals from different occupational classes or socioeconomic strata showed different mortality rates, an indicator that also varied according to area-level socioeconomic deprivation.[27, 28] Such differences may be related to differential patterns of healthcare utilisation in families with different family-level vulnerability characteristics, the greater vulnerability of residents in socioeconomically deprived areas, in which health care services are often limited, or a dynamic interaction between these and other factors.[29] However, evidence on differential impacts of public health crises on service utilisation, as opposed to health outcomes, remains scarce.[30]

In addition, organisational readiness for change may also play an important role in the ability of healthcare service providers to respond to changing circumstances that, in turn, can affect service provision. For example, at the beginning of the COVID-19 pandemic, PCPs had to reorganise multiple structures and processes in their practices under immense time pressure. This included the installation of physical barriers at reception desks and in consultation rooms, separate consultations for children with suspected infections or the extended use of telemedical services.[20, 31, 32] In general, implementing change in healthcare organisations has proven challenging given different perspectives on the change process and its consequences within teams, insufficient information disseminated by the practice management during the change process or a lack of time for preparing for change.[33]

Organisational readiness for implementing change (ORIC), an indicator of the potential for change within healthcare institutions,[34, 35] has been described as an organisational construct comprising two components: (1) change commitment, organisational members' shared resolve to implement a change, and (2) change efficacy, the shared belief in their collective capability to do so.[34] The extent to which ORIC plays an important role for paediatric primary care service provision during public health crises is unclear, yet such information could be valuable in improving the capacity of paediatric primary care to successfully respond to future challenges.

The current study will be among the first to comprehensively investigate disruptions to paediatric primary care service utilisation and provision during a major public health crisis and their underlying reasons. Insights from this study have the potential to improve the resilience of paediatric primary care and to contribute to continued high-quality and equitable primary care services for all children and adolescents. In addition, it will provide important insights that may help to minimise excess morbidity and mortality due to disruptions to paediatric primary care during the current and future public health crises.

Study objectives

In the COVID-19 PedCare Study we aim to explore leverage points to strengthen paediatric primary care services during the current pandemic and future public health crises. Specifically, we pursue the following primary and secondary objectives:

Primary objectives

1) To investigate the utilisation of paediatric primary care services by families during the COVID-19 pandemic and to describe barriers and facilitators of service utilisation from the perspective of parents and adolescents and

2) to assess the provision of paediatric primary care services during the COVID-19 pandemic and to explore barriers and facilitators of optimal service provision from the perspective of PCPs.

Secondary objectives

1) To assess the independent association between both family-level factors of vulnerability and area-level socioeconomic deprivation and paediatric primary care utilisation during the COVID-19 pandemic and

2) to investigate the association between ORIC and the provision of paediatric primary care services and to describe barriers and facilitators of ORIC.

METHODS AND ANALYSIS

Study design

The COVID-19 PedCare Study, funded by the Ministry of Science, Research and Arts of Baden-Wuerttemberg, is based on a convergent mixed-methods design [36] and consists of five parts (A-E; Figure 1). To enable a comprehensive assessment of service utilisation and provision we explore the perspectives of parents, adolescents and PCPs. Specifically, we conduct quantitative online surveys with parents (A), adolescents (B) and PCPs (C) and semistructured interviews with parents (D) and PCPs (E). We first collect and analyse quantitative and qualitative data separately and integrate the findings at the stage of interpretation.[36] Data collection for the online surveys and the semistructured interviews started in February and March 2021, respectively, and will be completed by August 2021. Given the lack of guidelines for the reporting of observational study protocols, the reporting in this manuscript is based on the SPIRIT and COREQ reporting guidelines.[37, 38]

Setting

The study is conducted in paediatric primary care practices. In Germany approximately 60, 20 and 20% of all children and adolescents below the age of 18 years receive primary care services from board-certified paediatricians, general practicioners and a combination of both, respectively.[39] Paediatric primary care practices are heterogeneous in size and organisational structure and include mostly solo and group practices. Paediatric primary care practices are predominantly headed by one or more PCPs and usually comprise several medical assistants. Depending on the size of the practice, further board-certified paediatricians, paediatric residents and paediatric nurses complement the practice teams.

Participants and recruitment

Parent and adolescent surveys (PARTS A and B)

We follow a two step process to recruit parents (A) and adolescents (B) for the online surveys. In the first step, the German Professional Association of Paediatricians (*Berufsverband der Kinder- und Jugendärzte*; BVKJ) has agreed to invite all PCPs in Baden-Wuerttemberg, a federal state of 11.1 million inhabitants in the southwest of Germany, to take part in the study.[40] Information on the study is distributed via the mailing list of the BVKJ. PCPs interested in participating in the study are invited to contact the research team and receive detailed information on study procedures. No exclusion criteria are defined at the level of PCPs. In the second step, participating PCPs and their staff are asked to invite all families consulting their practices to take part in the parent and adolescent online surveys by providing leaflets containing detailed information on the study. After having completed the parent survey, all parents with adolescents aged 12 years or older are asked to consent to their child's

participation in the adolescent survey. No exclusion criteria are defined for parents and adolescents. However, parents and adolescents unable to take part in an online survey (e.g., no internet access, no access to an electronic device) or unable to complete a survey in German or another language for which a translation is available (English, Turkish, Italian) are excluded from the study *de facto*.

Paediatrician survey (PART C)

To reduce the burden on PCPs, we conduct the paediatrician survey in different paediatric primary care practices than those involved in identifying parents and adolescents in Parts A and B. All members of the BVKJ with paediatric primary care practices in the German federal states of Bavaria (13.1 million inhabitants; number of PCPs: 1,080; southeastern part of Germany) and Berlin (3.8 million inhabitants; number of PCPs: 311) and all members of the German Society of Ambulatory Primary Care Paediatrics *(Deutsche Gesellschaft für Ambulante Allgemeine Pädiatrie*; DGAAP) are invited to participate in the paediatrician survey. The DGAAP is the academic association of PCPs in Germany with 210 current members and membership open to all paediatricians. Information on the study is distributed via the mailing lists of the BVKJ chapters in Bavaria and Berlin and the DGAAP. No exclusion criteria are defined for paediatricians in this part of the study. However, PCPs unable to take part in an online survey (e.g., no internet access, no access to an electronic device) are exluded from the study *de facto*.

Parent interview (PART D)

PCPs contributing to the recruitment of parents and adolescents for the online surveys advertise the opportunity for parents to participate in interviews by distributing flyers in their practices. Following contact with the research team, interested parents receive detailed information on the objectives of and procedures for the interview. To elicit different parental perspectives we use a purposive sampling strategy maximising the diversity of interviewees with respect to the following aspects: age of child/adolescent, age and gender of parent, having a child with/without chronic health condition, educational attainment and migration background. We anticipate achieving theme saturation after interviewing approximately 15 parents.

Paediatrician interview (PART E)

We also invite PCPs involved in identifying parents and adolescents in Parts A and B to participate in the paediatrician interview. PCPs receive an email detailing the objectives of and procedures for the interview and inviting them to contact the research team if interested in participating. To maximise the diversity of perspectives, recruitment is guided by the following aspects: gender, duration practising as a PCP, practice size (solo or proup practices), location of practice (rural or urban) and

area-level deprivation (operationalised by the estimated proportion of patients with low educational attainment). We anticipate achieving theme saturation after interviewing approximately 15 PCPs.

Incentives for study participation

Parents participating in the interviews receive a book voucher worth 20 Euros. PCPs contributing to the recruitment of parents or taking part in the paediatrician interview obtain an incentive for participation of 40 Euros due to the increased burden associated with recruitment and longer interviews.

Data collection

Parent and adolescent surveys (PARTS A and B)

Strict infection control measures preclude paper-based data collection at paediatric primary care practices. Given that 96 to 98% of Germans aged 20 to 49 years own a smartphone,[41] we implemented online surveys. Parents access the parent survey via a link or QR code on the leaflet distributed at their paediatric primary care practices and complete the anonymous survey on their own devices. Once parents with adolescents aged 12 years and older have completed the parent survey, they are asked to consent to the participation of their child in the adolescent survey. Adolescents complete the adolescent survey on their parents' device. The parent and adolescent surveys are implemented in LimeSurvey Version 3.22.1 (LimeSurvey GmbH, Hamburg, Germany) and underwent pretests with nine parents and three adolescents aged 12 to 18 years to ensure full comprehensibility. No adaptations were necessary for the parent and adolescent surveys after the pretests.

Paediatrician survey (PART C)

PCPs access the paediatrician survey via a link in the invitation email and complete the anonymous online survey on their devices. The paediatrician survey is implemented in LimeSurvey and underwent pretests with six PCPs, resulting in modification of the wording of a single question to enhance its comprehensibility.

PCPs contributing to the recruitment of parents and adolescents are also asked to complete the paediatrician survey. However, their data are recorded pseudonymously enabling the linkage of data between the parent, adolescent and paediatrician surveys based on the IDs of paediatric primary care practices that are recorded once parents submit the parent survey.

Parent and paediatrician interview (PARTS D and E)

Three members of the research team with prior training in qualitative research methods conduct the interviews either as video or phone interviews, depending on the interviewees' preferences (ME: MD; male; paediatrician, paediatric health services researcher and principle investigator of the study; NE: PhD; female; epidemiologist; LF: MSc; female; health scientist). We did not establish relationships with the interviewees prior to commencing the study. All interviews are audio-recorded and transcribed verbatim.

Measures

Parent and adolescent surveys (PARTS A and B)

Table 1 provides an overview of the parent and adolescent surveys including covered concepts and their respective operational definitions. The English version of the parent and adolescent surveys is provided in online supplementary appendix 1. Briefly, we cover seven sections in the parent survey: (1) utilisation of paediatric primary care services, (2) utilisation of telemedical services, (3) correlates of paediatric primary care utilisation, (4) leverage points for strengthening paediatric primary care, (5) aspects of child and (6) parental health, and (7) sociodemographic characteristics. Whenever available, we used validated scales. When no validated scales were available, we translated and adapted items from international studies (referenced in Table 1) or created new items. Furthermore, we assess several family-level factors of vulnerability pertaining to different sections of the parent survey such as parental educational attainment or symptoms of parental depression or anxiety (marked with * in Table 1). Based on a literature review, we cover several potential confounders of the association between family-level and area-level deprivation and service utilisation (marked with # in Table 1). In the adolescent survey we cover four sections: (1) utilisation of telemedical services, (2) correlates of paediatric primary care utilisation, (3) leverage points for strengthening paediatric primary care and (4) aspects of adolescent health. The items in the adolescent survey are based on the respective items in the parent survey. However, we simplified complex expressions such as telemedical services or COVID-19. To increase participation of families with mother tongues other than German, and thus to improve external validity, we provide the parent and adolescent surveys in German, English, Turkish and Italian. Whenever available, we used validated foreign-language versions of standardised scales (e.g., PHQ-4, CSHCN Screener).[42, 43] Professional translators translated the remainder of the parent and adolescents surveys. Each foreign-language version was independently checked by a second translator for content accuracy.

Table 1: Content of the parent and adolescent surveys (PARTS A and B)

Domain	Concept	Operational definition and psychometric properties	Parent survey (PART A)	Adolescent survey (PART B)
(1) Utilisation of paediatric primary care services	(1.A) Deferral and cancellation of different types of paediatric primary care services	Modified from McDonnell et al. [44] and own items	X	
(2) Utilisation of telemedical services	(2.A) Utilisation of different types of telemedical services before and during the COVID-19 pandemic	Own items	X	X
(3) Correlates of paediatric primary care utilisation	(3.A) Concerns about visiting the paediatric primary care practice (e.g., fear of infection in the paediatric primary care practice)	Modified from McDonnell et al. [44], own items as well as free-text question	X	X
	(3.B) Sense of security in paediatric primary care practice	Own item	X	X
	(3.C) Perceived implementation of infection control measures in paediatric primary care practice	Own item	X	
	(3.D) Personal experiences related to the pandemic (e.g., member of risk group in household, personal experience with quarantine)	Own item		
	(3.E) Fear of child's infection with COVID-19	Modified from McDonnell et al. [44]	X	X
	(3.F) Reasons for not using telemedical services (e.g., limited internet access, lack of technical equipment)	Own item	X	
(4) Leverage points for strengthening paediatric primary care	(4.A) Possibilities to facilitate carefree consultations at paediatric primary care practices during the COVID-19 pandemic	Free-text question	X	X
(5) Aspects of child health	(5.A) Chronic conditions of children*	CSHCN screener (adequate internal consistency [Cronbach's alpha: 0.76]; precise measurement among	X	

			children experiencing elevated health-condition-complexity trait levels)[43]		
	(5.B) Parent-/child-reported general child health status		KIGGS baseline study [45]	X	X
(6) Aspects of parental health	(6.A) General health status		One question of the Short Form 36 Health Survey Questionnaire (SF-36; accectable internal consistency [Cronbach's alpha: > 0.85; reliability coefficient > 0.75 for all dimensions except social functioning], excellent test-retest reliability, substantial evidence for construct validity [46])	X	
	(6.B) Parental stress*		Perceived Stress Scale-4 (PSS-4; adequate internal consistency [Cronbach's alpha: 0.60];[47] construct validity was shown for the PSS-10, which the PSS-4 is based on, in a German population [48])	X	
	(6.C) Perceived parental depression and anxiety*#[49]		Patient Health Questionnaire-4 (PHQ-4; scale to screen for symptoms of depression and anxiety; good internal consistency [Cronbach's alpha: 0.82}; convergent validity was shown in a German population)[42]	X	
(7) Sociodemographic characteristics	Child	(7.A) Age#[50]	In years	X	
		(7.B) Gender	Female/ male	X	
		(7.C) Migration background*#[51]	Migration background if either one parent or the child was not born as German citizen	X	

	Parent	(7.D) Age	< 20 years 20 – 29 years 30 – 39 years 40 – 49 years 50 – 59 years ≥ 60 years	**X**	
		(7.E) Gender	Female/ male	**X**	
		(7.F) Educational attainment*#[52]	KIGGS baseline study;[45] based on the International Standard Classification of Education (ISCED-2011)[53]	**X**	
		(7.G) Single parent*#[54]	Single parent/ nuclear family	**X**	

The English version of all adapted items and all items developed for this study are provided in the online supplementary appendix 1. For the validated scales we provide references in the column *operational definition and psychometric properties*. A subset of items of the parent survey are also included in the adolescent survey. The respective items are marked in the last column. Family-level factors of vulnerability potentially driving adverse changes in service utilisation are marked with *. Potential confounders of the association between family-level and area-level deprivation and service utilisation are marked with # and referenced in the table. COVID-19, coronavirus disease 2019; CSHCN, children with special health care needs; KIGGS, German Health Interview and Examination Survey for Children and Adolescents (Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland); ISCED, International Standard Classification of Education.

Area-level socioeconomic deprivation

We use the German Index of Socioeconomic Deprivation (GISD) to investigate area-level socioeconomic deprivation, described in detail elsewhere.[55] In brief, the index comprises three dimensions, namely education, occupation and income, each consisting of a different number of factors. While the three dimensions have equal weight, the weights of the contributing factors were determined by factor analyses. To assess area-level deprivation, we use GISD data at the level of municipalities classified into three categories based on quintiles of socioeconomic deprivation as recommended by the developers of the GISD (low [lowest quintile], medium [middle three quintiles] and high [highest quintile]). The GISD values are provided in the public domain by Kroll et al.[56]

Paediatrician survey (PART C)

Table 2 provides an overview of the content of the paediatrician survey including the concepts and their respective operational defintions. The survey (see online supplementary appendix 2) addresses nine topics: (1) provision of paediatric primary care services, (2) provision of telemedical services, (3) infection control measures implemented in paediatric primary care practices, (4) correlates of paediatric primary care service provision, (5) ORIC, (6) leverage points for strengthening paediatric primary care services, (7) aspects of PCP health, (8) sociodemographic and professional and (9) practice characteristics. Whenever available, we used validated scales. When no validated scales were available, we translated and adapted items from international studies (referenced in Table 2) or created new items.

Table 2: Content of the paediatrician survey (PART C)

Domain	Concept	Operational definition and psychometric properties
(1) Provision of paediatric primary care services	(1.A) Deferral and cancellation of different types of paediatric primary care services	Own item
	(1.B) Change in opening hours	Own item
	(1.C) Provision of COVID-19-specific services (e.g., SARS-CoV-2 smears, medical certificates)	Own item
(2) Provision of telemedical services	(2.A) Provision of different types of telemedical services before and during the COVID-19 pandemic	Own item
(3) Infection control measures implemented in paediatric primary care practices	(3.A) Implementation of infection control measures in paediatric primary care practices (e.g., masks, social distancing, separate infectious disease consultations)	Own item
(4) Correlates of paediatric primary care service provision	(4.A) Factors related to the pandemic affecting service provision (e.g., staff shortage, implementation of time consuming infection control measures)	Own item
	(4.B) Reasons for not providing telemedical services (e.g., limited internet access, lack of technical equipment)	Own item
	(4.C) Opinion towards telemedical services	Own item
	(4.D) Personal experiences related to the pandemic (e.g., member of risk group, personal experience with quarantine)	Own item
(5) Organisational readiness for implementing change (ORIC)	(5.A) Change commitment, defined as the organisational members' shared resolve to implement a change	Change commitment scale of ORIC (good content and structural validity as well as internal consistency and inter-rater reliability [57])
	(5.B) Change efficacy, defined as the organisational members' shared belief in the collective capability to implement a change	Change efficacy scale of ORIC (good content and structural validity as well as internal consistency and inter-rater reliability [57])

(6) Leverage points for strengthening paediatric primary care services	(6.A) Concerns and support needs related to the upcoming months	Free-text questions
	(6.B) Ideas how to improve paediatric primary care services during the COVID-19 pandemic for children and adolescents in general and those with special healthcare needs	Free-text questions
(7) Aspects of PCP health	(7.A) General health status	One question of the Short Form 36 Health Survey Questionnaire (SF-36; accectable internal consistency [Cronbach's alpha > 0.85; reliability coefficient > 0.75 for all dimensions except social functioning], excellent test-retest reliability, substantial evidence for construct validity [46])
	(7.B) Burden related of the COVID-19 pandemic	Modified from Foley et al. [58] and Kramer et al. [59] and own items
	(7.C) Stress of paediatrician	Perceived Stress Scale-4 (PSS-4; adequate internal consistency [Cronbach's alpha: 0.60];[47] construct validity was shown for the PSS-10, which the PSS-4 is based on, in a German population [48])
	(7.D) Perceived paediatrician depression and anxiety	Patient Health Questionnaire-4 (PHQ-4; scale to screen for symptoms of depression and anxiety; good internal consistency [Cronbach's alpha: 0.82]; convergent validatity was shown in a German population)[42]
(8) Sociodemographic and professional characteristics	(8.A) Age	< 30, 30 – 39, 40 – 49, 50 – 59, ≥ 60 years
	(8.B) Gender	Female/ male
	(8.C) Number and age of own children	Number of children aged 0 – 1, 2 – 5, 6 – 11 and 12 - 18 years
	(8.D) Subspecialty training	Yes No No, I am still in residency
	(8.E) Experience in paediatric primary care	< 5, 5 – 9, 10 – 19, 20 – 29, 30 – 39, ≥ 40 years
	(8.F) Employment status	Self-employed/ employed

	(8.G) Weekly working hours	< 10, 10 – 19, 20 – 29, 30 – 39, 40 – 49, ≥ 50 hours
(9) Practice characteristics	(9.A) Type of practice	Solo practice Group practice Multispecialty medical care centre
	(9.B) Pratice size	Based on the number of statutory health insurance claims and the number of children with private health insurance
	(9.C) Population of the municipality the paediatric primary care practice is located in	< 5,000, 5,000 to < 20,000, 20,000 to < 50,000, 50,000 to < 100,000, 100,000 to < 500,000, ≥ 500,000 inhabitants

The English version of all adapted items and all items developed for this study are provided in the online supplementary appendix 2. For the validated scales, we provide references in the column *operational definition and psychometric properties*. COVID-19, coronavirus disease 2019; ORIC, organisational readiness for implementing change, PCP, primary care paediatrician

Interview guides for the parent and paediatrician interviews (PARTS D and E)

The interviews are based on interview guides comprising open-ended and non-directive questions. We iteratively refined initial drafts of the interview guides following discussions within the research team. The content of the final interview guides for the parent and paediatrician interviews are summarised in Table 3. The first three interviews were used to pretest the interview guides with parents and PCPs to ensure comprehensibility of the guiding questions. As no major changes were applied after the pretests, we will include the pretest interviews in the qualitative content analysis.

Table 3: Content of the interview guides for parents and primary care paediatricians

Interview guide for parents • Care at the paediatric primary care practice during the COVID-19 pandemic • Experiences with telemedical services in paediatric primary care • Leverage points for strengthening paediatric primary care to ensure high-quality care for children and adolescents during the COVID-19 pandemic
Interview guide for primary care paediatricians • Service provision in paediatric primary care practices during the COVID-19 pandemic • Experiences with providing telemedical services during the COVID-19 pandemic • Motivation, i.e. change commitment, and capabilities, i.e. change efficacy, of paediatric primary care practice teams to implement changes during the COVID-19 pandemic • Possibilities to support paediatric primary care practices in providing high-quality care during the COVID-19 pandemic • Leverage points for strengthening paediatric primary care to ensure high-quality care for children and adolescents during the pandemic

PCP, primary care paediatrician; COVID-19, coronavirus disease 2019.

Sample size considerations

Due to the exploratory nature of the study, we did not conduct formal sample size calculations. Based on previous studies in paediatric primary care, we anticipate a response rate for the paediatrician survey between 10 – 15% amounting to 160 – 240 completed surveys. Moreover, we aim to sample 750 parents for the parent survey.

Analysis

Parent, adolescent and paediatrician surveys (PARTS A, B and C)

We will use univariate analyses to describe the provision and utilisation of paediatric primary care services during the COVID-19 pandemic. For paediatric primary care practices whose parents and adolescents participate in the parent and adolescent surveys, we will link data from the parent, adolescent and paediatrician surveys. This will enable us to consider correlates of paediatric primary care utilisation both at family-level such as migration background or parental educational attainment and practice-level like practice size or implementation of infection control measures. Taking into account the clustering of parent surveys in paediatric primary care practices, associations between the utilisation of paediatric primary care services and correlates will be assessed with generalised linear mixed models incorporating a random effect for paediatric primary care practices. Associations between the provision of paediatric primary care services and correlates will be investigated with generalised linear mixed models incorporating a random effect for the federal state.

To investigate the independent association between paediatric primary care utilisation and (a) family-level factors of vulnerability such as migration background or single parent status and (b) area-level socioeconomic deprivation operationalised by the GISD [55] we will fit multivariable generalised linear mixed models with a random effect for paediatric primary care practice and adjusting for potential confounders. The association between ORIC and changes in the provision of services in paediatric primary care practices will be investigated with multivariable generalised linear mixed models.

We will consider p-values < 0.05 for two-sided tests significant. All analyses will be performed in RStudio (Version 1.3.1093 , RStudio, Boston, MA).

Parent and paediatrician interviews (PARTS D and E)

We will apply qualitative content analysis to analyse the parent and paediatrician interviews.[60] We will use a mixed coding strategy comprising both deductive and inductive elements. At the outset we will deduce codes from the interview guides. During the analysis process, we will refine the initial coding scheme by adding additional codes as they emerge from the interview material. Within codes we will finally identify major and minor themes by paraphrasing coded text segments and by subsequently summarising paraphrases with related meaning.[60] Each interview will be analysed independently by two out of three researchers (ME; LF; SK). Interim results will be regularly presented and discussed in meetings of the research team. Discrepancies will be resolved by discussions. We will use MAXQDA 12.3 to conduct the qualitative content analysis (VERBI Software GmbH, Berlin, Germany).

Integrated interpretation of quantitative and qualitative results

Utilisation and provision of paediatric primary care services are multifaceted phenomena. Given this complexity, combining the findings from the quantitative and qualitative analyses at the interpretation stage will facilitate the recognition of important insights related to each of the study objectives. Specifically, we will use findings from the semistructured interviews to illustrate results from the online surveys, combine qualitative and quantitative results to triangulate findings and potentially explore inconsistencies in results from the two methods to gain additional insights.[61]

Patient and public involvement

Parents, adolescents and PCPs were not directly involved in the development of the study objectives and the study design. However, we considered the feedback of several parents, adolescents and PCPs when preparing the online surveys and interview guides.

ETHICS AND DISSEMINATION

Ethical considerations

The COVID-19 PedCare Study fully complies with the Declaration of Helsinki [62] and was approved by the Medical Ethics Review Board of the Medical Faculty Mannheim at Heidelberg University (2020-650N). We obtain written informed consent from all parents and PCPs participating in the interviews and from PCPs taking part in the recruitment of parents and adolescents for the online surveys to allow for data linkage between the three surveys. The parent and adolescent surveys are exempt from written informed consent as only anonymous data are collected.

Output and dissemination

Study results will be presented at national and international health services research conferences and will be published in journals with external peer-review. The data will be made available upon reasonable request.

DISCUSSION

The COVID-19 PedCare Study has great potential for adding to our understanding of the response of paediatric primary care to major public health crises by comprehensively assessing the utilisation and provision of paediatric primary care services and their barriers and facilitators from the perspectives of parents, adolescents and PCPs. We anticipate this study will help to increase the resilience of paediatric primary care and thus limit excess morbidity and mortality as it contributes to the development of strategies to minimise disruptions to service utilisation and provision during public

health crises. The study will complement the limited evidence on disruptions to service utilisation and provision in other sectors of paediatric healthcare such as elective surgeries [10, 11] or paediatric emergency care.[1-4] The study results will be based on self-report data and will therefore provide an authentic view of paediatric primary care during a major public health crisis as perceived by important stakeholders. Additional insights could be gained by exploring the results of this study alongside objective measures of utilisation. A future study from this research group will therefore examine objective changes in utilisation of paediatric primary care services compared to the prepandemic period based on billing data.

By assessing the independent association between family-level vulnerability factors and area-level deprivation and paediatric primary care service utilisation, the study will help to identify families and communities particularly vulnerable to adverse changes in service utilisation during pandemics. Health authorities could use the study results to plan and implement targeted communication and outreach activities to prevent or at least attenuate unfavourable changes in service utilisation. At the family-level, our results could help PCPs to identify families that would particularly benefit from close follow-up during public health crises and thus help to focus scarce resources of PCPs to the most vulnerable patients and families, containing and possibly reducing health disparities. Furthermore, to the best of our knowledge the study will be the first to assess ORIC in paediatric primary care and to identify factors strengthening ORIC in this setting. We anticipate that these results could support practice teams to successfully implement necessary changes under time pressure during future public health crises.

Limitations

We acknowledge several limitations of this exploratory study. First, the following limits to the generalisability of our findings should be considered: (1) We use non-probability sampling for the online surveys. (2) Families exclusively relying on services of general practicioners are not covered in the study (20% of children and adolescents in Germany).[39] (3) The study is limited to families consulting PCPs during the ongoing COVID-19 pandemic as recruitment for the study is conducted in paediatric primary care practices. Families completely avoiding consultations in paediatric primary care (e.g., due to fear of infection) are exluded *de facto*. Despite these limitations to generalisability, our findings have the potential to provide important first insights into a complex topic with multi-dimensional influences. Future studies may overcome these limitations by including general practitioners and by increasing efforts to sample families not consulting PCPs during public health crises. In this context, computer-assisted telephone interviews based on a sample of families drawn from registers of residents could generate complementary insights.

Second, we are not able to attribute study results to particular phases of the pandemic such as lockdown or inter-lockdown periods as differentiating between different phases of the pandemic retrospectively would probably be associated with substantial recall bias. The results will however provide valuable insights into service utilisation and provision during pandemics in general and might therefore be useful in devising generic strategies to limit disruptions to service utilisation and provision in light of major public health crises. Finally, due to limited resources we are unable to conduct interviews with adolescents. While we are able to cover important aspects of service utilisation in the adolescent survey, future qualitative studies might complement our findings by uncovering previously unrecognised correlates of service utilisation not covered in the current quantitative adolescent survey.

Authors' contributions

ME is the principal investigator of the study. NE, LF, SK and ME conceptualised the study and developed the online surveys. NE, LF, SK, DL and ME developed the interview guides. NE, LF and SK are responsible for the study logistics. JK provided input to the analysis strategy. NE, LF, SK and ME contributed to the first draft of the manuscript. All authors made substantial contributions to subsequent drafts and approved the final manuscript.

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Competing interests statement

None declared.

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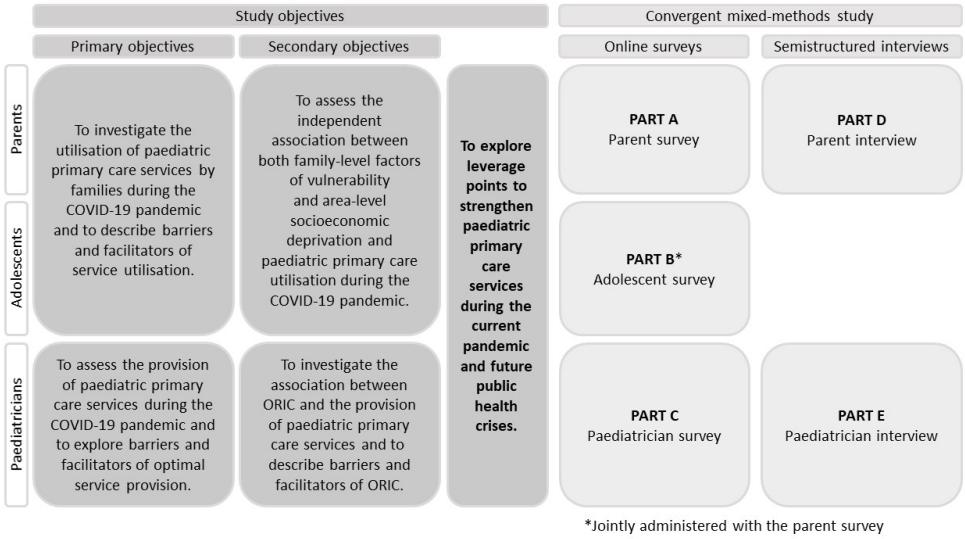
Figure 1: Overview of the COVID-19 PedCare Study - Objectives and study parts

To enable a comprehensive assessment of the utilisation and provision of paediatric primary care services the COVID-19 PedCare study uses a convergent mixed-methods design comprising quantitative online surveys and semistructured interviews and integrates the perspectives of parents, adolescents and primary care paediatricians. ORIC, organisational readiness for implementing change; COVID-19, coronavirus disease 2019.



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Supplementary appendices

Appendix 1: Content of the parent and adolescent surveys – items adapted from other studies and items developed for the present study

(1) Utilisation of paediatric primary care services

(1.A) Deferral and cancellation of different types of paediatric primary care services

Please remember the time since the beginning of the COVID-19 pandemic:
Apart from your visit today, were there any reasons to visit a paediatrician with your child?

- Yes
- No

if *Yes:*
Did you then visit the paediatrician?

- Yes, always
- Yes, sometimes
- No

if *Yes, sometimes* or *No*:
Which of the following examinations/treatments did you postpone or cancel during the pandemic?
Please tick all that apply.

- Examination/treatment due to an acute illness
- Routine examination or check-up due to a chronic illness
- Vaccination
- Routine child health check-up ("U-Untersuchung")
- Other examinations: _____

(2) Utilisation of telemedical services

(2.A) Utilisation of different types of telemedical services before and during the COVID-19 pandemic

Which of the following telemedical services did you use to contact your paediatrician before the COVID-19 pandemic began?
Please tick all that apply.

- Video consultation
- Telephone consultation
- E-mail/online chat
- Telemonitoring (e.g. transmission of blood sugar values from patients to paediatricians)
- Keeping a digital diary of symptoms (e.g. of headaches or abdominal pain) and transmitting the data to the paediatrician
- Other: _____

Which of the following telemedical services have you used for the first time since the beginning of the COVID-19 pandemic to contact your paediatrician?
Please tick all that apply.

- Video consultation
- Telephone consultation
- E-mail/online chat
- Telemonitoring (e.g. transmission of blood sugar values from patients to paediatricians)

- Keeping a digital diary of symptoms (e.g. of headaches or abdominal pain) and transmitting the data to the paediatrician
- Other: _____

(3) Correlates of paediatric primary care utilisation

(3.A) Concerns about visiting the paediatric primary care practice

Since the beginning of the COVID-19 pandemic, what are your concerns when visiting a paediatrician?
Free-text question

Since the beginning of the COVID-19 pandemic, have you been more or less concerned about visiting a paediatrician with your child than before the pandemic?

- Much more
- Somewhat more
- The same
- Somewhat less
- Much less

When thinking back on the visits to your paediatrician since the beginning of the COVID-19 pandemic: To what extent do you agree with the following statements?
Fully agree - rather agree - neither agree nor disagree - rather disagree - disagree completely

- I am worried that we could be infected with COVID-19 in the paediatrician's office.
- I am worried that a visit to the paediatrician's office will not be welcome unless it is an emergency.
- I think that the doctor is currently needed more urgently by other children.
- I think the government's recommendations mean that we should not visit the paediatrician's office.
- I am worried that the office is extremely busy and we have to wait a very long time.
- I don't own a car and don't like to use public transport.

(3.B) Sense of security in paediatric primary care practice

How safe do you feel regarding the risk of infection when you visit your paediatrician's office with your child during the COVID-19 pandemic?

- Very safe
- Safe
- Neutral
- Unsafe
- Very unsafe

(3.C) Perceived implementation of infection control measures in paediatric primary care practice

Are the infection prevention measures in your paediatrician's office sufficient in your opinion?

- Absolutely sufficient
- Rather sufficient
- Rather insufficient
- Absolutely insufficient

(3.D) Personal experiences related to the pandemic

Are there people in your household at risk for COVID-19 (e.g. elderly people, people with pre-existing conditions)?

- Yes

- No
- I don't know

What situations applied to you or any other person in your household since the beginning of the COVID-19 pandemic?
Please tick all that apply.

- Preventive self-isolation due to a chronic disease/pre-existing condition
- Quarantine due to suspicion of COVID-19 infection
- Quarantine due to confirmed COVID-19 infection
- Quarantine due to contact with a person with suspected or confirmed COVID-19 infection
- Quarantine after having stayed in a COVID-19 risk area
- Hospitalisation due to confirmed COVID-19 illness

(3.E) Fear of child's infection with COVID-19

Are you concerned that your child could be infected with COVID-19?

- Not worried at all
- A little worried
- Moderately worried
- Rather worried
- Very worried

How bad do you think the disease will be if your child is infected with COVID-19?

- Not bad at all
- Not so bad
- Moderately bad
- Quite bad
- Very bad

(3.F) Reasons for not using telemedical services

If no telemedical services are or were used:
Why don't you use telemedical services?
Please tick all that apply.

- My paediatrician's office does not offer telemedical services.
- I don't have the necessary technical equipment (e.g. laptop, computer).
- I don't have reliable and fast internet access.
- I don't have the necessary technical skills to use telemedical services.
- I am missing the personal contact with the paediatrician when using telemedical services.
- In my opinion, the use of telemedical services is associated with a lower quality of care.
- I have privacy concerns when using telemedical services.
- I encounter communication problems when using telemedical services (e.g. limited knowledge of German).
- Other reasons: _____

(4) Leverage points for strengthening paediatric primary care

(4.A) Possibilities to facilitate carefree consultations at paediatric primary care practices during the COVID-19 pandemic

What would have to change in order for you to be able to visit a paediatrician without any concerns during the COVID-19 pandemic?
Free-text question

(7) Sociodemographic characteristics

(7.A) Child age

Please state the age of your child:
If your child is under one year of age, please enter 0 years.
___ year(s)

(7.B) Child gender
Please state the gender of your child:
- Female
- Male

(7.C) Migration background
What was your nationality at birth?
German, Afghan, Bosnian, Bulgarian, Chinese, French, Greek, Iraqi, Italian, Kosovar, Croatian, Austrian, Polish, Portuguese, Romanian, Russian, Serbian, Spanish, Syrian, Turkish, Hungarian, Dual nationality, Other

What was the nationality of the other parent at birth?
German, Afghan, Bosnian, Bulgarian, Chinese, French, Greek, Iraqi, Italian, Kosovar, Croatian, Austrian, Polish, Portuguese, Romanian, Russian, Serbian, Spanish, Syrian, Turkish, Hungarian, Dual nationality, Other, I don't know

What was the nationality of your child at birth?
When answering questions about your child, please remember to answer for the child with whom you are visiting your paediatrician today. If you are visiting with several children, please answer for the oldest child.
German, Afghan, Bosnian, Bulgarian, Chinese, French, Greek, Iraqi, Italian, Kosovar, Croatian, Austrian, Polish, Portuguese, Romanian, Russian, Serbian, Spanish, Syrian, Turkish, Hungarian, Dual nationality, Other

(7.D) Parent age
Please state your age:
- < 20 years
- 20 – 29 years
- 30 – 39 years
- 40 – 49 years
- 50 – 59 years
- ≥ 60 years

(7.E) Parent gender
Please state your gender:
- Female
- Male

(7.G) Single parent
Are you a single parent?
- Yes
- No

Appendix 2: Content of the paediatrician survey – items adapted from other studies and items developed for the present study

(1) Provision of paediatric primary care services

(1.A) Deferral and cancellation of different types of paediatric primary care services

Have you postponed or cancelled any consultations since the COVID-19 pandemic began?

- o No
- o Yes

If *Yes*:

Which of the following examinations/treatments did you postpone or cancel during the pandemic?

Please tick all that apply.

- o Examinations/treatments due to an acute illness
- o Routine examinations or check-ups due to a chronic illness
- o Routine child health check-ups ("U-Untersuchungen")
- o Vaccinations
- o Other examinations: _____

Did your practice have to close temporarily due to the COVID-19 pandemic?

- o No
- o Yes

If *Yes*:

- o Yes, ____ weeks

(1.B) Change in opening hours

Have the opening hours of your practice changed since the start of the COVID-19 pandemic?

- o No
- o Yes

If *Yes*:

To what extent have the opening hours of your practice changed since the start of the COVID-19 pandemic?

Please tick all that apply.

- o Currently reduced opening hours
- o Currently extended opening hours
- o Temporarily reduced opening hours in the past (e.g. during lockdown)
- o Temporarily extended opening hours in the past (e.g. during lockdown)

If *Yes*:

For what reasons have you changed your regular opening hours?

Please tick all that apply.

- o Staff shortage due to sick leave
- o Staff shortage due to quarantine of employees
- o Staff shortage due to preventive measures (e.g. risk groups staying away from the workplace)
- o Staff shortage due to obligations caring for children or relatives
- o Higher administrative workload than before the start of the COVID-19 pandemic
- o Infection control measures could not be implemented with regular opening hours
- o More patients than at the same time last year

- Fewer patients than at the same time last year
- Personal reasons
- Other reasons: _____

(1.C) Provision of COVID-19-specific services

How many COVID-19 smears do you currently take per day on average?

- < 5 smears/day
- 5 – 9 smears/day
- 10 – 14 smears/day
- 15 – 19 smears/day
- ≥ 20 smears/day

How many certificates do you currently issue on average per day in connection with the COVID-19 pandemic (e.g. at the request of kindergartens or schools)?

- < 5 certificates/day
- 5 – 9 certificates/day
- 10 – 14 certificates/day
- 15 – 19 certificates/day
- ≥ 20 certificates/day

(2) Provision of telemedical services

(2.A) Provision of different types of telemedical services before and during the COVID-19 pandemic

Do you use telemedical services in your practice?

- Yes
- No, but the use is being prepared
- No, I won't use it in a foreseeable time

If *Yes*:

Which of the following telemedical services did you use before the COVID-19 pandemic began?

Please tick all that apply.

- Video consultation
- Telephone consultation
- E-mail/online chat
- Telemonitoring (e.g. transmission of blood sugar values from patients to paediatricians)
- Keeping a digital diary of symptoms (e.g. of headaches or abdominal pain) and transmitting the data to the paediatrician
- Other: _____

If *Yes*:

Which of the following telemedical services have you used for the first time since the beginning of the COVID-19 pandemic?

Please tick all that apply.

- Video consultation
- Telephone consultation
- E-mail/online chat
- Telemonitoring (e.g. transmission of blood sugar values from patients to paediatricians)
- Keeping a digital diary of symptoms (e.g. of headaches or abdominal pain) and transmitting the data to the paediatrician
- Other: _____

If *No, but the use is being prepared*:
Which of the following telemedical services is your practice currently preparing to use?
Please tick all that apply.

- ○ Video consultation
- ○ Telephone consultation
- ○ E-mail/online chat
- ○ Telemonitoring (e.g. transmission of blood sugar values from patients to paediatricians)
- ○ Keeping a digital diary of symptoms (e.g. of headaches or abdominal pain) and transmitting the data to the paediatrician
- ○ Other: _____

If *Yes*:
What proportion of patient consultations did you handle via telemedical services before the COVID 19 pandemic, i.e. before March 2020?
Please estimate the proportion.

- ○ 0%
- ○ 1% - 4%
- ○ 5% - 9%
- ○ 10% - 49%
- ○ ≥ 50%

If *Yes*:
What proportion of patient consultations have you handled via telemedical services in the last 4 weeks?
Please estimate the proportion.

- ○ 0%
- ○ 1% - 4%
- ○ 5% - 9%
- ○ 10% - 49%
- ○ ≥ 50%

(3) Infection control measures implemented in paediatric primary care practices

(3.A) Implementation of infection control measures in paediatric primary care practices

Which of the following infection control measures are being implemented in your practice due to the COVID-19 pandemic?
Yes - no, as not useful - no, but would be useful

- ○ Consultation by appointment only
- ○ Parents and children wait outside the practice prior to the consultation.
- ○ Measures to ensure distancing between families in the practice (e.g. floor marking for queues, reduced number of chairs in the waiting room)
- ○ Consistent enforcement of mask-wearing for parents
- ○ Consistent enforcement of mask-wearing for children and adolescents aged 10 years and older.
- ○ Consistent enforcement of mask-wearing for children 6 – 9 years of age
- ○ Consistent enforcement of mask-wearing for children below 6 years of age
- ○ Consistent enforcement of mask-wearing for practice staff
- ○ Separate consulting hours for children with symptoms consistent with COVID-19 infection (e.g. infection consultations) and children with other conditions (e.g. vaccination or screening consultations)

- Spatial separation between children with symptoms compatible with COVID-19 infection and children with other complaints (e.g. use of an "infection room" or "infection area")
- Additional hygiene measures for parents and children (e.g. hand disinfection or hand washing after entering the practice)
- Implementation of additional disinfection measures after each patient contact
- Structural measures to protect against infection (e.g. installation of physical barriers at reception desks)
- Use of personal protective equipment during physical examinations of children and adolescents with symptoms of infection
- Use of personal protective equipment when taking nasopharyngeal swabs
- Implementing screening measures among staff
- Regular airing of the practice rooms

What other infection control measures are being implemented in your practice due to the COVID-19 pandemic?
Free-text question

What other infection control measures should be implemented in your practice beyond the existing measures?
Free-text question

Do you need support to implement appropriate infection control measures in your practice in the coming months?
- Yes
- No

If *Yes*:
What support do you need?
Free-text question

(4) Correlates of paediatric primary care service provision

(4.A) Factors related to the pandemic affecting service provision

How much do the following factors currently affect your daily practice?
Very much – considerably – not so much – not at all
- Staff shortage due to sick leave
- Staff shortage due to quarantine of employees
- Staff shortage due to preventive measures (e.g. risk groups staying away from the workplace)
- Staff shortage due to obligations caring for children or relatives
- Higher administrative workload than before the start of the COVID 19 pandemic
- Time-consuming infection control measures
- Costly infection control measures
- More patients than at the same time last year
- Fewer patients than at the same time last year

(4.B) Reasons for not providing telemedical services

If no telemedical services are or were used:
Why don't you use telemedical services?
Please tick all that apply.
- I don't have the necessary IT infrastructure in practice.

- I don't have reliable and fast internet access.
- I don't have the necessary technical skills to use telemedical services.
- I consider personal contact with patients and parents to be indispensable.
- I don't have the time to establish telemedical services in the practice.
- I don't reach all families with telemedical services.
- There is a lack of demand for telemedical services among families.
- Other reasons: _____

(4.C) Opinion towards telemedical services

To what extent do you agree with the following statements?

Fully agree; rather agree; neither agree nor disagree; rather disagree; disagree completely

- Telemedical services are associated with lower quality of treatment.
- Telemedical care is more time-consuming than care without telemedical services.
- I have data protection concerns about the use of telemedical services.
- Most of the families I care for want telemedical care.
- I would like more support in the use of telemedical services (e.g. in the form of training, information material, technical support).
- I prefer personal contact.

(4.D) Personal experiences related to the pandemic

Which of the following statements apply to you?

Please tick all that apply.

- I myself belong to a risk group for COVID-19 (e.g. due to my age or due to pre-existing conditions).
- I had to (temporarily) reduce or suspend my work in the practice during the COVID-19 pandemic due to childcare obligations or the care of relatives.
- I self-isolated as a precautionary measure due to a chronic disease/pre-existing condition.
- I had to self-isolate because I was suspected of having a COVID-19 infection.
- I had to self-isolate because I had a confirmed COVID-19 infection.
- I had to self-isolate because I had contact with a person with suspected or confirmed COVID-19 infection.
- I had to self-isolate because I had been in a COVID-19 risk area.
- I had to be hospitalised because of a confirmed COVID-19 illness.

(6) Leverage points for strengthening paediatric primary care services

(6.A) Concerns and support needs related to the upcoming months

To what extent do you agree with the following statement?

Fully agree; rather agree; neither agree nor disagree; rather disagree; disagree completely

- As a practising primary care paediatrician, I am worried when I think about the coming months.

If *Fully agree* or *Rather agree*:

What worries you when you think about the coming months?

Free-text question

What support do you need so that you, as a practising paediatrician, can handle the coming months well?

Free-text question

(6.B) Ideas how to improve paediatric primary care services during the COVID-19 pandemic for children and adolescents in general and those with special healthcare needs

What would have to be done so that as many children and adolescents as possible can be cared for adequately in paediatric primary care during the COVID 19 pandemic?
Free-text question

The care of children and adolescents with chronic diseases is an important task of paediatricians in private practice.
What do you think needs to be done to ensure that children and adolescents with chronic diseases can also be cared for adequately during the COVID 19 pandemic?
Free-text question

(7) Aspects of primary care paediatrician health

(7.B) Burden related of the COVID-19 pandemic

To what extent do you agree with the following statements?
Fully agree; rather agree; neither agree nor disagree; rather disagree; disagree completely

- I am worried that I will be infected with COVID-19 at work.
- I am worried that I may infect people around me with COVID-19 because of my work.
- I have changed my socialising and travel patterns because of the COVID-19 pandemic (e.g. I avoid large crowds or public transport).
- The COVID-19 pandemic has led to an increase in my daily workload.
- Due to the COVID-19 pandemic, I have significantly less time for my personal life.
- Since the COVID-19 pandemic, I have been sleeping less well.
- I feel that my work is appreciated by families during the COVID-19 pandemic.
- Since the outbreak of the COVID-19 pandemic, the satisfaction with my job has worsened.
- I feel left alone by the responsible political decision-makers.
- Due to the COVID-19 pandemic I feel mentally strained.
- My everyday life at home has become significantly more stressful due to the COVID-19 pandemic.
- Due to the COVID-19 pandemic, I am worrying more often about the future.
- Due to the COVID-19 pandemic, I am worrying more often about the well-being of my family.
- I feel stressed by the infection control measures in my everyday work.

(8) Sociodemographic and professional characteristics

(8.A) Age

Please state your age:

- < 30 years
- 30 – 39 years
- 40 – 49 years
- 50 – 59 years
- ≥ 60 years

(8.B) Gender

Please state your gender:

- Female
- Male

(8.C) Number and age of own children

The following is about your own children.
Questions about the children and adolescents you care for in your practice can be found further on in the questionnaire.
Do you have children?

- Yes

- No

If *Yes*:
How many children do you have in each of the following age groups?
- 0 – 1 year: ___ child(ren)
- 2 - 5 years: ___ child(ren)
- 6 – 11 years: ___ child(ren)
- 12 - 18 years: ___ child(ren)

(8.D) Subspecialty training
Have you completed a fellowship after finishing paediatric residency?
- Yes
- No
- No, I am still in residency

(8.E) Experience in paediatric primary care
How many years have you been working in outpatient paediatric primary care?
- < 5 years
- 5 – 9 years
- 10 – 19 years
- 20 – 29 years
- 30 – 39 years
- ≥ 40 years

(8.F) Employment status
Do you run your own practice as a self-employed paediatrician or do you work in primary care as an employed doctor?
- Self-employed
- Employed

(8.G) Weekly working hours
How many hours per week do you work in your practice?
- < 10 hours
- 10 – 19 hours
- 20 – 29 hours
- 30 – 39 hours
- 40 – 49 hours
- ≥ 50 hours

(9) Practice characteristics

(9.A) Type of practice
In what type of practice are you currently working?
- Solo practice
- Group practice
- Multispecialty medical care centre
- Other: _____

(9.B) Practice size
How many statutory health insurance claims are processed in your practice per quarter?
- 0 – 299
- 300 – 599
- 600 – 899

- 900 – 1199
- 1200 – 1499
- ≥ 1500

Please estimate the percentage of patients in your practice with private health insurance:
____ %

(9.C) Population of the municipality the paediatric primary care practice is located in
How many inhabitants are there in the municipality/city your practice is located in?

- < 5,000
- 5,000 to < 20,000
- 20,000 to < 50,000
- 50,000 to < 100,000
- 100,000 to < 500,000
- ≥ 500,000

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Service provision and utilisation in German paediatric primary care practices during public health crises: Protocol of the mixed-methods COVID-19 PedCare Study

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Service provision and utilisation in German paediatric primary care practices during public health crises: Protocol of the mixed-methods COVID-19 PedCare Study

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ABSTRACT

Introduction

Public health crises such as pandemics can cause serious disruptions to the utilisation and provision of healthcare services with negative effects on morbidity and mortality. Despite the important role of paediatric primary care in maintaining high-quality healthcare services during crises, evidence about service utilisation and provision remains limited especially in Germany. This study therefore explores the utilisation and provision of paediatric primary care services during the ongoing COVID-19 pandemic and their barriers and facilitators.

Methods and analysis

The study uses a convergent mixed-methods design and comprises online surveys to parents, adolescents and primary care paediatricians (PCPs) and semi-structured interviews with parents and PCPs. We recruit parents and adolescents from paediatric primary care practices and PCPs via email using mailing lists of the German Professional Association of Paediatricians and the German Society of Ambulatory Primary Care Paediatrics. The parent and adolescent surveys assess, *inter alia*, the utilisation of paediatric primary care services and its correlates, aspects of parental and child health as well as socioeconomic characteristics. The PCP survey examines the provision of paediatric primary care services and its correlates, aspects of PCP health as well as sociodemographic and practice characteristics. The semi-structured interviews with parents and PCPs explore several aspects of the online surveys in more detail. We use descriptive statistics and generalised linear mixed models to assess service utilisation and provision and specific correlates covered in the online surveys and apply qualitative content analysis to explore barriers and facilitators of service utilisation and provision more broadly in the semi-structured interviews. We will integrate findings from the quantitative and qualitative analyses at the interpretation stage.

Ethics and Dissemination

The study was approved by the Medical Ethics Review Board of the Medical Faculty Mannheim at Heidelberg University (2020-650N). Study results will be published in journals with external peer-review.

Keywords

COVID-19, paediatrics, organisation of health services, quality in health care

Strengths and limitations of the study

- The current study is among the first to comprehensively explore utilisation and provision of paediatric primary care services as well as their barriers and facilitators during a major public health crisis in Germany.
- Using a convergent mixed-methods design we explore the perspectives of parents, adolescents and primary care paediatricians.
- The rate of response to the parent and adolescent surveys may limit generalisability of the quantitative findings, although semi-structured interviews will be useful in uncovering insights that will guide future research in this area.
- We are not able to attribute findings to particular phases of the pandemic such as lockdown or inter-lockdown periods.

INTRODUCTION

Public health crises such as pandemics can cause severe disruptions to both the provision of paediatric healthcare services and their utilisation.[1, 2] Both provision and utilisation of services should be considered to fully understand the impact of crises on healthcare systems and to identify strategies to strengthen their resilience because high-quality care might be compromised by disruptions to service provision, decreased service utilisation or a combination of both.

The extent to which the utilisation and provision of paediatric healthcare services is affected by public health crises is not fully understood. Substantial changes in the utilisation of paediatric emergency care were observed during past epidemics.[1-3] Early evidence on the ongoing coronavirus disease 2019 (COVID-19) pandemic and its concomitant lockdown and social distancing measures suggests declines in the utilisation of paediatric healthcare services including paediatric emergency care,[4] services for children with special healthcare needs such as occupational therapy or physiotherapy [5] and vaccinations.[6-9] Service provision during the COVID-19 pandemic has been compromised by cancellations or deferrals of elective or non-emergency surgeries and by temporary closures of paediatric oncology departments.[10-12]

Reduced utilisation of paediatric healthcare services and disruptions to service provision during public health crises can contribute to higher morbidity and mortality. An increased proportion of severe ketoacidosis in children and adolescents newly diagnosed with type 1 diabetes and more complications in young people with acute appendicitis during the COVID-19 pandemic, compared to the pre-pandemic period, were most likely caused by delayed presentation.[13-15] It is expected that the deferral of chronic care during the pandemic will be accompanied by increased morbidity and mortality in the future.[16]

Paralleling the role of General Medicine for adult patients, paediatric primary care plays an important role in responding to disruptions to service utilisation and provision during public health crises.[17] Several countries in Europe and elsewhere (e.g., Spain, Czech Republic, USA) have paediatrician-based systems or ones in which both general practitioners, family doctors and paediatricians provide paediatric primary care (e.g., Austria, France, Germany).[18] In countries with paediatrician-based and combined systems, primary care paediatricians (PCPs) are the first point of contact with the healthcare system for most children and adolescents, providing acute, chronic and preventive care, counselling as well as coordination of services with community-based service providers.

Paediatric primary care has the potential to contribute to high-quality healthcare services during public health crises due to its role in the provision of accessible and equitable services in light of

protracted emergencies and its potential to reduce non-emergency-related morbidity and mortality.[17] Minimising disruptions to service utilisation and provision in paediatric primary care should therefore be a priority. To our knowledge, however, only one study has examined the utilisation of paediatric primary care services during the COVID-19 pandemic, reporting declines in in-person-consultations ranging from 40% to more than 80% between March and August 2020 compared to previous years.[19]

Reasons for reduced utilisation of paediatric healthcare services during pandemics are not well understood. Potential explanations may include parental fear of infection,[20, 21] pending mandatory SARS-CoV-2-test results [20] or disruptions to service provision due to closed healthcare facilities, staff shortages [22] or changes in practice opening hours.[23] Given its central role within the healthcare system especially during public health crises, studies comprehensively assessing the scope of disruptions to paediatric primary care service utilisation and provision, their associated factors and leverage points to strengthen paediatric primary care in times of crises are urgently needed.

Socioeconomic factors may introduce additional forces that affect service utilisation during public health crises differentially, aggravating existing health inequalities.[24, 25] During past epidemics, for example, health outcome indicators such as morbidity and mortality rates differed by socioeconomic characteristics at multiple levels: Individuals from different occupational classes or socioeconomic strata showed different mortality rates, an indicator that also varied according to area-level socioeconomic deprivation.[26, 27] Such differences may be related to differential patterns of healthcare utilisation in families with different family-level vulnerability characteristics, the greater vulnerability of residents in socioeconomically deprived areas, in which health care services are often limited, or a dynamic interaction between these and other factors.[28] However, evidence on differential impacts of public health crises on service utilisation, as opposed to health outcomes, remains scarce.[29]

In addition, organisational readiness for change may also play an important role in the ability of healthcare service providers to respond to changing circumstances that, in turn, can affect service provision. For example, at the beginning of the COVID-19 pandemic, PCPs had to reorganise multiple structures and processes in their practices under immense time pressure. This included the installation of physical barriers at reception desks and in consultation rooms, separate consultations for children with suspected infections or the extended use of telemedical services.[19, 30, 31] In general, implementing change in healthcare organisations has proven challenging given different perspectives on the change process and its consequences within teams, insufficient information disseminated by the practice management during the change process or a lack of time for preparing for change.[32]

Organisational readiness for implementing change (ORIC), an indicator of the potential for change within healthcare institutions,[33, 34] has been described as an organisational construct comprising two components: (1) change commitment, organisational members' shared resolve to implement a change, and (2) change efficacy, the shared belief in their collective capability to do so.[33] The extent to which ORIC plays an important role for paediatric primary care service provision during public health crises is unclear, yet such information could be valuable in improving the capacity of paediatric primary care to successfully respond to future challenges.

Here, we describe the protocol for a study, which will be among the first to comprehensively investigate disruptions to paediatric primary care service utilisation and provision during a major public health crisis and their underlying reasons. Insights from this study have the potential to improve the resilience of paediatric primary care and to contribute to continued high-quality and equitable primary care services for all children and adolescents. In addition, it will provide important insights that may help to minimise excess morbidity and mortality due to disruptions to paediatric primary care during the current and future public health crises.

Study objectives

In the COVID-19 PedCare Study, we aim to explore leverage points to strengthen paediatric primary care services during the current pandemic and future public health crises. Specifically, we pursue the following primary and secondary objectives:

Primary objectives

1) To investigate the utilisation of paediatric primary care services by families during the COVID-19 pandemic and to describe barriers and facilitators of service utilisation from the perspective of parents and adolescents and

2) to assess the provision of paediatric primary care services during the COVID-19 pandemic and to explore barriers and facilitators of optimal service provision from the perspective of PCPs.

Secondary objectives

1) To assess the independent association between both family-level factors of vulnerability and area-level socioeconomic deprivation and paediatric primary care utilisation during the COVID-19 pandemic and

2) to investigate the association between ORIC and the provision of paediatric primary care services and to describe barriers and facilitators of ORIC.

METHODS AND ANALYSIS

Study design

The COVID-19 PedCare Study, funded by the Ministry of Science, Research and Arts of Baden-Wuerttemberg, Germany, is based on a convergent mixed-methods design [35] and consists of five parts (A-E; Figure 1). To enable a comprehensive assessment of service utilisation and provision, we explore the perspectives of parents, adolescents and PCPs. Specifically, we conduct quantitative online surveys with parents (A), adolescents (B) and PCPs (C) and semi-structured interviews with parents (D) and PCPs (E). We first collect and analyse quantitative and qualitative data separately and integrate the findings at the stage of interpretation.[35] Data collection for the online surveys and the semi-structured interviews started in February and March 2021, respectively, and will be completed by August 2021. The reporting in this manuscript is based on the CHERRIES [36] and COREQ [37] reporting guidelines.

Setting

The study is conducted in Germany, a nation with universal health care coverage, in paediatric primary care practices. Approximately 60, 20 and 20% of all German children and adolescents below the age of 18 years receive primary care services from board-certified paediatricians, general practitioners or a combination of both, respectively.[38] Paediatric primary care practices are heterogeneous in size and organisational structure and consist of mostly solo and group practices. Paediatric primary care practices are predominantly headed by one or more PCPs and usually comprise several medical assistants. Depending on the size of the practice, other board-certified paediatricians, paediatric residents and paediatric nurses may complement practice teams.

Participants and recruitment

Parent and adolescent surveys (PARTS A and B)

We follow a two-step process to recruit parents (A) and adolescents (B) for the online surveys. In the first step, the German Professional Association of Paediatricians (*Berufsverband der Kinder- und Jugendärzte*; BVKJ) has agreed to invite all PCPs in Baden-Wuerttemberg, a federal state of 11.1 million inhabitants in the southwest of Germany, to take part in the study.[39] Information on the study is distributed via the mailing list of the BVKJ. PCPs interested in participating in the study are invited to contact the research team via email and receive detailed information on study procedures. No exclusion criteria are defined at the level of PCPs. In the second step, participating PCPs and their staff are asked to invite families consulting their practices to take part in the parent and adolescent online surveys by providing leaflets containing detailed information on the study. The parent and adolescent

surveys are open surveys targeting all parents and adolescents visiting the paediatric primary care practices and result in a convenience sample of the target population. To reduce selection bias, we ask PCPs to consecutively invite parents and adolescents for participation. After having completed the parent survey, all parents with adolescents aged 12 years or older are asked to consent to their child's participation in the adolescent survey. No exclusion criteria are defined for parents and adolescents. However, those unable to take part in an online survey (e.g., no internet access, no access to an electronic device) or to complete a survey in German or in a version translated into one of the three languages most often spoken by families with migration background in the target region (English, Turkish, Italian)[40] are excluded from the study *de facto*.

Paediatrician survey (PART C)

Out of respect for increased demands faced by PCPs during the pandemic and to reduce the burden of participation, we conduct the paediatrician survey in different paediatric primary care practices than those involved in identifying parents and adolescents in Parts A and B. All members of the BVKJ with paediatric primary care practices in the German federal states of Bavaria (13.1 million inhabitants; number of PCPs: 1,080; south-eastern part of Germany) and Berlin (3.8 million inhabitants; number of PCPs: 311) and all members of the German Society of Ambulatory Primary Care Paediatrics *(Deutsche Gesellschaft für Ambulante Allgemeine Pädiatrie*; DGAAP) are invited to participate in the paediatrician survey. The DGAAP is the academic association of PCPs in Germany with 210 current members and membership open to all paediatricians. Information on the study is distributed via email using the mailing lists of the BVKJ chapters in Bavaria and Berlin and the DGAAP. The paediatrician survey is an open survey aimed at all PCPs within the target population and without the application of exclusion criteria. PCPs without internet access or access to an electronic device are excluded from the study *de facto*.

Parent interview (PART D)

PCPs contributing to the recruitment of parents and adolescents for the online surveys advertise the opportunity for parents to participate in interviews by distributing flyers in their practices. Following contact with the research team, interested parents receive detailed information on the objectives of and procedures for the interview. To elicit different parental perspectives, we use a purposive sampling strategy maximising the diversity of interviewees with respect to the following aspects: age of child/adolescent, age and gender of parent, having a child with/without chronic health condition, educational attainment and migration background. We anticipate achieving theme saturation after interviewing approximately 15 parents.

Paediatrician interview (PART E)

We also invite PCPs involved in identifying parents and adolescents in Parts A and B to participate in the paediatrician interview. PCPs receive an email detailing the objectives of and procedures for the interview and inviting them to contact the research team if interested in participating. To maximise the diversity of perspectives, recruitment is guided by the following aspects: gender, duration practising as a PCP, practice size (solo or group practices), location of practice (rural or urban) and area-level deprivation (operationalised by the estimated proportion of patients with low educational attainment). We anticipate achieving theme saturation after interviewing approximately 15 PCPs.

Incentives for study participation

Parents participating in the interviews receive a book voucher worth 20 Euros. PCPs contributing to the recruitment of parents or taking part in the paediatrician interview obtain an incentive for participation of 40 Euros due to the increased burden associated with recruitment and longer interviews. Monetary or in-kind incentives for completion of the study surveys are not offered.

Data collection

Parent and adolescent surveys (PARTS A and B)

Strict infection control measures preclude paper-based data collection at paediatric primary care practices. Given that 93 to 96% of Germans aged 14 to 59 years own a smartphone,[41] we used LimeSurvey (Version 3.22.1, LimeSurvey GmbH, Hamburg, Germany), a customisable online survey platform, to produce and deliver the parent and adolescent surveys. Parents access the parent survey via a link or QR code on the leaflet distributed at their paediatric primary care practices and complete the anonymous survey on their own devices. Once parents with adolescents aged 12 years and older have completed the parent survey, they are asked to consent to the participation of their child in the adolescent survey. Adolescents complete the adolescent survey on their parents' device. Given an adaptive design used to limit respondent burden and increase the response rate, the parent and adolescent surveys (online supplementary appendix 1) contain a maximum of 52 and 12 items, respectively, translating into an estimated completion time of 20 minutes in total.

Paediatrician survey (PART C)

PCPs access the paediatrician survey via a link in the invitation email and complete the anonymous online survey, produced using LimeSurvey, on their devices. Similar to the adaptive design used for the parent and adolescent surveys, the paediatrician survey (online supplementary appendix 2)

contains a maximum of 54 items with an estimated completion time of 15 minutes. PCPs contributing to the recruitment of parents and adolescents are also asked to complete the paediatrician survey. However, their data are recorded pseudonymously enabling the linkage of data between the parent, adolescent and paediatrician surveys based on the IDs of paediatric primary care practices that are recorded once parents submit the parent survey.

Technical details of data collection in the online surveys (PARTS A, B and C)

Items are introduced non-randomly in the online surveys. We provide non-response options for all items and enforce selection of one response option throughout, as advised in previous work.[36] Participants are able to review and change previously chosen response options using back and forward buttons in the online surveys. No completeness checks are conducted prior to survey submission. To comply with data protection regulations in effect in Germany, we do not use cookies or store IP-addresses of study participants. For the pseudonymous paediatrician survey, PCPs receive a personalised token only valid once, thereby avoiding duplicate entries. For the anonymous parent, adolescent and paediatrician surveys, we do not use tokens. After study completion, data will be stored for ten years. Only members of the research team have access to the data.

Parent and paediatrician interview (PARTS D and E)

Three members of the research team with prior training in qualitative research methods conduct the interviews either by video conferencing or telephone, depending on interviewees' preferences (ME: MD; male; paediatrician, paediatric health services researcher and principal investigator of the study; NE: PhD; female; epidemiologist; LF: MSc; female; health scientist). We did not establish relationships with the interviewees prior to commencing the study. All interviews are conducted in German and are audio-recorded and transcribed verbatim.

Measures

Parent and adolescent surveys (PARTS A and B)

Table 1 provides an overview of the parent and adolescent surveys including the concepts addressed and the sources of items and scales. Briefly, we cover seven sections in the parent survey: (1) utilisation of paediatric primary care services, (2) utilisation of telemedical services, (3) correlates of paediatric primary care utilisation, (4) leverage points for strengthening paediatric primary care, (5) aspects of child and (6) parental health, and (7) sociodemographic characteristics. Whenever available, we used validated scales. When no validated scales were available, we translated and adapted items from international studies (referenced in Table 1) or created new items. Furthermore,

we assess several family-level factors of vulnerability pertaining to different sections of the parent survey such as parental educational attainment or symptoms of parental depression or anxiety (marked with * in Table 1). Based on a literature review, we cover several potential confounders of the association between family-level and area-level deprivation and service utilisation (marked with # in Table 1). In the adolescent survey we cover four sections: (1) utilisation of telemedical services, (2) correlates of paediatric primary care utilisation, (3) leverage points for strengthening paediatric primary care and (4) aspects of adolescent health. The items in the adolescent survey are based on the respective items in the parent survey. However, we simplified complex expressions such as telemedical services or COVID-19. To increase participation of families speaking languages other than German, and thus to improve external validity, we provide translations of the parent and adolescent surveys in English, Turkish and Italian. Whenever available, we used validated foreign-language versions of standardised scales (e.g., PHQ-4, CSHCN Screener).[42, 43] Professional translators translated the remainder of the parent and adolescents surveys. Each foreign-language version was independently checked by a second translator for content accuracy. The parent and adolescent surveys underwent pretests with nine parents and three adolescents aged 12 to 18 years to ensure full comprehensibility and technical functionality of the online survey. No adaptations were necessary for the parent and adolescent surveys after the pretests.

Table 1: Content of the parent and adolescent surveys (PARTS A and B)

Domain	Concept	Source of items and scales	Parent survey (PART A)	Adolescent survey (PART B)
(1) Utilisation of paediatric primary care services	(1.A) Deferral and cancellation of different types of paediatric primary care services	Modified from McDonnell et al. [44]	X	
(2) Utilisation of telemedical services	(2.A) Utilisation of different types of telemedical services before and during the COVID-19 pandemic	+	X	X
(3) Correlates of paediatric primary care utilisation	(3.A) Concerns about visiting the paediatric primary care practice (e.g., fear of infection in the paediatric primary care practice)	Modified from McDonnell et al. [44] as well as free-text question	X	X
	(3.B) Sense of security in paediatric primary care practice	+	X	X
	(3.C) Perceived implementation of infection control measures in paediatric primary care practice	+	X	
	(3.D) Personal experiences related to the pandemic (e.g., member of risk group in household, personal experience with quarantine)	+	X	
	(3.E) Fear of child's infection with COVID-19	Modified from McDonnell et al. [44]	X	X
	(3.F) Reasons for not using telemedical services (e.g., limited internet access, lack of technical equipment)	+	X	
(4) Leverage points for strengthening paediatric primary care	(4.A) Possibilities to facilitate lower risk consultations at paediatric primary care practices during the COVID-19 pandemic	Free-text question	X	X
(5) Aspects of child health	(5.A) Chronic conditions of children*	CSHCN screener (adequate internal consistency [Cronbach's alpha: 0.76]; precise measurement among	X	

			children experiencing elevated health-condition-complexity trait levels)[43]		
	(5.B) Parent-/child-reported general child health status		KIGGS baseline study [45]	X	X
(6) Aspects of parental health	(6.A) General health status		A single item from the Short Form 36 Health Survey Questionnaire (SF-36; acceptable internal consistency [Cronbach's alpha: > 0.85; reliability coefficient > 0.75 for all dimensions except social functioning], excellent test-retest reliability, substantial evidence for construct validity [46])	X	
	(6.B) Parental stress*		Perceived Stress Scale-4 (PSS-4; adequate internal consistency [Cronbach's alpha: 0.60];[47] construct validity was shown for the PSS-10, which the PSS-4 is based on, in a German population [48])	X	
	(6.C) Perceived parental depression and anxiety*#[49]		Patient Health Questionnaire-4 (PHQ-4; scale to screen for symptoms of depression and anxiety; good internal consistency [Cronbach's alpha: 0.82}; convergent validity was shown in a German population)[42]	X	
(7) Sociodemographic characteristics	Child	(7.A) Age#[50]	In years	X	
		(7.B) Gender	Female/ male	X	
		(7.C) Migration background*#[51]	Migration background if either one parent or the child was not born as German citizen	X	

	Parent	(7.D) Age	< 20 years 20 – 29 years 30 – 39 years 40 – 49 years 50 – 59 years ≥ 60 years	**X**	
		(7.E) Gender	Female/ male	**X**	
		(7.F) Educational attainment*#[52]	KIGGS baseline study;[45] based on the International Standard Classification of Education (ISCED-2011)[53]	**X**	
		(7.G) Single parent*#[54]	Single parent/ nuclear family	**X**	

Notes: The English version of all items developed for this study and all adapted items are provided in the online supplementary appendix 1. A subset of items of the parent survey are also included in the adolescent survey.

+ Items developed by the research team

* Family-level factors of vulnerability potentially driving adverse changes in service utilisation

Potential confounders of the association between family-level and area-level deprivation and service utilisation

COVID-19, coronavirus disease 2019; CSHCN, children with special health care needs; KIGGS, German Health Interview and Examination Survey for Children and Adolescents *(Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland*); ISCED, International Standard Classification of Education.

Area-level socioeconomic deprivation

We use the German Index of Socioeconomic Deprivation (GISD) to investigate area-level socioeconomic deprivation, described in detail elsewhere.[55] In brief, the index comprises three dimensions, namely education, occupation and income, each consisting of a different number of factors. While the three dimensions have equal weight, the weights of the contributing factors were determined by factor analyses. To assess area-level deprivation, we use GISD data at the level of municipalities classified into three categories based on quintiles of socioeconomic deprivation as recommended by the developers of the GISD (low [lowest quintile], medium [middle three quintiles] and high [highest quintile]). The GISD values are provided in the public domain by Kroll et al.[56]

Paediatrician survey (PART C)

Table 2 provides an overview of the content of the paediatrician survey including the concepts addressed and the sources of items and scales. The survey covers nine topics: (1) provision of paediatric primary care services, (2) provision of telemedical services, (3) infection control measures implemented in paediatric primary care practices, (4) correlates of paediatric primary care service provision, (5) ORIC, (6) leverage points for strengthening paediatric primary care services, (7) aspects of PCP health, (8) sociodemographic and professional and (9) practice characteristics. Whenever available, we used validated scales. When no validated scales were available, we translated and adapted items from international studies (referenced in Table 2) or created new items. The paediatrician survey underwent pretests with six PCPs, resulting in modification of the wording of a single item to enhance its comprehensibility. No modifications were required with respect to the technical functionality of the online survey.

Table 2: Content of the paediatrician survey (PART C)

Domain	Concept	Source of items and scales
(1) Provision of paediatric primary care services	(1.A) Deferral and cancellation of different types of paediatric primary care services	+
	(1.B) Change in opening hours	+
	(1.C) Provision of COVID-19-specific services (e.g., SARS-CoV-2 smears, medical certificates)	+
(2) Provision of telemedical services	(2.A) Provision of different types of telemedical services before and during the COVID-19 pandemic	+
(3) Infection control measures implemented in paediatric primary care practices	(3.A) Implementation of infection control measures in paediatric primary care practices (e.g., masks, social distancing, separate infectious disease consultations)	+
(4) Correlates of paediatric primary care service provision	(4.A) Factors related to the pandemic affecting service provision (e.g., staff shortage, implementation of time-consuming infection control measures)	+
	(4.B) Reasons for not providing telemedical services (e.g., limited internet access, lack of technical equipment)	+
	(4.C) Opinion towards telemedical services	+
	(4.D) Personal experiences related to the pandemic (e.g., member of risk group, personal experience with quarantine)	+
(5) Organisational readiness for implementing change (ORIC)	(5.A) Change commitment, defined as the organisational members' shared resolve to implement a change	Change commitment scale of ORIC (good content and structural validity as well as internal consistency and inter-rater reliability [57])
	(5.B) Change efficacy, defined as the organisational members' shared belief in the collective capability to implement a change	Change efficacy scale of ORIC (good content and structural validity as well as internal consistency and inter-rater reliability [57])

(6) Leverage points for strengthening paediatric primary care services	(6.A) Concerns and support needs related to the upcoming months	Free-text questions
	(6.B) Ideas how to improve paediatric primary care services during the COVID-19 pandemic for children and adolescents in general and those with special healthcare needs	Free-text questions
(7) Aspects of PCP health	(7.A) General health status	One question of the Short Form 36 Health Survey Questionnaire (SF-36; acceptable internal consistency [Cronbach's alpha > 0.85; reliability coefficient > 0.75 for all dimensions except social functioning], excellent test-retest reliability, substantial evidence for construct validity [46])
	(7.B) Burden related of the COVID-19 pandemic	Modified from Foley et al. [58] and Kramer et al. [59]
	(7.C) Stress of paediatrician	Perceived Stress Scale-4 (PSS-4; adequate internal consistency [Cronbach's alpha: 0.60];[47] construct validity was shown for the PSS-10, which the PSS-4 is based on, in a German population [48])
	(7.D) Perceived paediatrician depression and anxiety	Patient Health Questionnaire-4 (PHQ-4; scale to screen for symptoms of depression and anxiety; good internal consistency [Cronbach's alpha: 0.82]; convergent validity was shown in a German population)[42]
(8) Sociodemographic and professional characteristics	(8.A) Age	< 30, 30 – 39, 40 – 49, 50 – 59, ≥ 60 years
	(8.B) Gender	Female/ male
	(8.C) Number and age of own children	Number of children aged 0 – 1, 2 – 5, 6 – 11 and 12 - 18 years
	(8.D) Subspecialty training	Yes No No, I am still in a residency training programme
	(8.E) Experience in paediatric primary care	< 5, 5 – 9, 10 – 19, 20 – 29, 30 – 39, ≥ 40 years
	(8.F) Employment status	Self-employed/ employed

	(8.G) Weekly working hours	< 10, 10 – 19, 20 – 29, 30 – 39, 40 – 49, ≥ 50 hours
(9) Practice characteristics	(9.A) Type of practice	Solo practice Group practice Multispecialty medical care centre
	(9.B) Practice size	Based on the number of statutory health insurance claims and the number of children with private health insurance
	(9.C) Population of the municipality the paediatric primary care practice is located in	< 5,000, 5,000 to < 20,000, 20,000 to < 50,000, 50,000 to < 100,000, 100,000 to < 500,000, ≥ 500,000 inhabitants

Notes: The English version of all items developed for this study and all adapted items are provided in the online supplementary appendix 2.

+ Items developed by the research team.

COVID-19, coronavirus disease 2019; ORIC, organisational readiness for implementing change, PCP, primary care paediatrician.

Interview guides for the parent and paediatrician interviews (PARTS D and E)

The interviews are based on interview guides comprising open-ended and non-directive questions. We iteratively refined initial drafts of the interview guides following discussions within the research team. The content of the final interview guides for the parent and paediatrician interviews are summarised in Table 3. The first three interviews were used to pretest the interview guides with parents and PCPs to ensure comprehensibility of the guiding questions. As no major changes were applied after the pretests, we will include the pretest interviews in the qualitative content analysis.

Table 3: Content of the interview guides for parents and primary care paediatricians

Interview guide for parents • Care at the paediatric primary care practice during the COVID-19 pandemic • Experiences with telemedical services in paediatric primary care • Leverage points for strengthening paediatric primary care to ensure high-quality care for children and adolescents during the COVID-19 pandemic
Interview guide for primary care paediatricians • Service provision in paediatric primary care practices during the COVID-19 pandemic • Experiences with providing telemedical services during the COVID-19 pandemic • Motivation, i.e. change commitment, and capabilities, i.e. change efficacy, of paediatric primary care practice teams to implement changes during the COVID-19 pandemic • Possibilities to support paediatric primary care practices in providing high-quality care during the COVID-19 pandemic • Leverage points for strengthening paediatric primary care to ensure high-quality care for children and adolescents during the pandemic

PCP, primary care paediatrician; COVID-19, coronavirus disease 2019.

Sample size considerations

Due to the exploratory nature of the study, we did not conduct formal sample size calculations. Based on previous studies in paediatric primary care and out of respect for the increased challenges facing paediatricians during the pandemic, we anticipate a response rate for the paediatrician survey between 10 – 15% amounting to 160 – 240 completed surveys. Moreover, we aim to sample 750 parents for the parent survey.

Analysis

Parent, adolescent and paediatrician surveys (PARTS A, B and C)

We will use univariate analyses to describe the provision and utilisation of paediatric primary care services during the COVID-19 pandemic. For paediatric primary care practices whose parents and adolescents participate in the parent and adolescent surveys, we will link data from the parent, adolescent and paediatrician surveys. This will enable us to consider correlates of paediatric primary care utilisation both at the family-level such as migration background or parental educational attainment and at the practice-level like practice size or implementation of infection control measures. Taking into account the clustering of parent surveys in paediatric primary care practices, associations between the utilisation of paediatric primary care services and correlates will be assessed with generalised linear mixed models incorporating a random effect for paediatric primary care practices. Associations between the provision of paediatric primary care services and correlates will be investigated with generalised linear models.

To investigate the independent association between paediatric primary care utilisation and (a) family-level factors of vulnerability such as migration background or single parent status and (b) area-level socioeconomic deprivation operationalised by the GISD [55] we will fit multivariable generalised linear mixed models with a random effect for paediatric primary care practice, adjusting for potential confounders. The association between ORIC and changes in the provision of services in paediatric primary care practices will be investigated with multivariable generalised linear models.

We will consider p-values < 0.05 for two-sided tests significant and will conduct complete case analyses. Completeness of data will be assessed by investigating missing data at item-level. All analyses will be performed in RStudio (Version 1.3.1093 , RStudio, Boston, MA).

Parent and paediatrician interviews (PARTS D and E)

We will apply qualitative content analysis to analyse the parent and paediatrician interviews.[60] We will use a mixed coding strategy comprising both deductive and inductive elements. At the outset we will deduce codes from the interview guides. During the analysis process, we will refine the initial coding scheme by adding additional codes as they emerge from the interview material. Within codes we will finally identify major and minor themes by paraphrasing coded text segments and by subsequently summarising paraphrases with related meaning.[60] Each interview will be analysed independently by two out of three researchers (ME; LF; SK). Interim results will be regularly presented and discussed in meetings of the research team. Discrepancies will be resolved by discussions. We will use MAXQDA 12.3 to conduct the qualitative content analysis (VERBI Software GmbH, Berlin, Germany).

Integrated interpretation of quantitative and qualitative results

Utilisation and provision of paediatric primary care services are multifaceted phenomena. Given this complexity, combining the findings from the quantitative and qualitative analyses at the interpretation stage will facilitate the recognition of important insights related to each of the study objectives. Specifically, we will use findings from the semi-structured interviews to illustrate results from the online surveys, combine qualitative and quantitative results to triangulate findings and potentially explore inconsistencies in results from the two methods to gain additional insights.[61] Data will not be integrated at the analysis stage by converting qualitative and quantitative data into the other data type, respectively.

Patient and public involvement

Parents, adolescents and PCPs were not directly involved in the development of the study objectives and the study design. However, we considered the feedback of several parents, adolescents and PCPs when preparing the online surveys and interview guides.

ETHICS AND DISSEMINATION

Ethical considerations

The COVID-19 PedCare Study fully complies with the Declaration of Helsinki [62] and was approved by the Medical Ethics Review Board of the Medical Faculty Mannheim at Heidelberg University (2020-650N). Participation in all study parts is voluntary. We obtain written informed consent from all parents and PCPs participating in the interviews and from PCPs taking part in the recruitment of parents and adolescents for the online surveys to allow for data linkage between the three surveys. The parent and adolescent surveys are exempt from written informed consent as only anonymous data are collected.

Output and dissemination

Study results will be presented at national and international health services research conferences and will be published in journals with external peer-review. The data will be made available upon reasonable request.

DISCUSSION

The COVID-19 PedCare Study has great potential for adding to our understanding of the response of paediatric primary care to major public health crises by comprehensively assessing the utilisation and provision of paediatric primary care services and their barriers and facilitators from the perspectives

of parents, adolescents and PCPs. We anticipate this study will help to increase the resilience of paediatric primary care and thus limit excess morbidity and mortality as it contributes to the development of strategies to minimise disruptions to service utilisation and provision during public health crises. The study will complement the limited evidence on disruptions to service utilisation and provision in other sectors of paediatric healthcare such as elective surgeries [10, 11] or paediatric emergency care.[1-4] The study results will be based on self-report data and will therefore provide an authentic view of paediatric primary care during a major public health crisis as perceived by important stakeholders. Additional insights could be gained by exploring the results of this study alongside objective measures of utilisation. A future study from this research group will therefore examine objective changes in utilisation of paediatric primary care services compared to the prepandemic period based on billing data.

By assessing the independent association between family-level vulnerability factors and area-level deprivation and paediatric primary care service utilisation, the study will help to identify families and communities particularly vulnerable to adverse changes in service utilisation during pandemics. Health authorities could use the study results to plan and implement targeted communication and outreach activities to prevent or at least attenuate unfavourable changes in service utilisation. At the family-level, our results could help PCPs to identify families that would particularly benefit from close follow-up during public health crises and thus help to focus scarce resources of PCPs to the most vulnerable patients and families, containing and possibly reducing health disparities. Furthermore, to the best of our knowledge the study will be the first to assess ORIC in paediatric primary care and to identify factors strengthening ORIC in this setting. We anticipate that these results could support practice teams to successfully implement necessary changes under time pressure during future public health crises.

Limitations

We acknowledge several limitations of this exploratory study. The following limits to the generalisability of our findings should be considered: (1) We use non-probability sampling for the online surveys. (2) Families exclusively relying on services of general practitioners are not covered in the study (20% of children and adolescents in Germany).[38] (3) Recruitment into this study is limited to families who *realised access* to health care services by consulting a PCP during the ongoing COVID-19 pandemic.[63] Families who despite universal health care coverage chose not to seek consultation in paediatric primary care (i.e., those with *potential access*) for whatever reason are excluded *de facto*. This group might overlap with families with other dimensions of social or economic vulnerability for whom continued support by PCPs might be particularly important during public health crises. (4) The

parent and adolescent surveys are only available in German, English, Turkish and Italian. While state statistics document that these languages are most often spoken by families in the target region of the surveys,[40] we exclude families speaking other languages *de facto*, potentially including particularly vulnerable groups such as recent immigrants or refugees. Despite these limitations to generalisability, our findings have the potential to provide important first insights into a complex topic with multi-dimensional influences. Future studies may overcome these limitations by including general practitioners and by increasing efforts to sample families not consulting PCPs during public health crises. In this context, computer-assisted telephone interviews based on a sample of families drawn from registers of residents could generate complementary insights. Studies specifically targeting socially or economically vulnerable families (e.g., recent immigrants, refugees, those with parents with mental health problems) may also be useful in broadening our understanding of patterns and gaps that exist in paediatric primary care service utilisation during public health crises. Similarly, exploring strategies for these families that may better facilitate access to care when needed (e.g., resources for increasing family support or involvement of bilingual community workers in service provision) could be valuable in addressing disparities in health and well-being.[64] Use of recruitment strategies that involve representatives of faith communities or recognised community leaders may also be beneficial in increasing reach, while use of research approaches tailored to the specific needs or preferences of potential participants (e.g., development of surveys in less commonly spoken languages, use of more structured interviewing techniques) also represent future potential directions.

We are not able to attribute study results to particular phases of the pandemic such as lockdown or inter-lockdown periods as differentiating between different phases of the pandemic retrospectively would probably be associated with substantial recall bias. The results will however provide valuable insights into service utilisation and provision during pandemics in general and might therefore be useful in devising generic strategies to limit disruptions to service utilisation and provision in light of major public health crises. Furthermore, due to limited resources we are unable to conduct interviews with adolescents. While we are able to cover important aspects of service utilisation in the adolescent survey, future qualitative studies might complement our findings by uncovering previously unrecognised correlates of service utilisation not covered in the current quantitative adolescent survey.

Due to increased demands placed on paediatric practices in the delivery of care during the ongoing COVID-19 pandemic including the implementation of strict infection control measures, it is not logistically feasible to collect data from non-responders. This limitation highlights the medium-term need for and potential value of improving the research capacity of paediatric primary care practices

that may arise from enhancing IT infrastructure and strengthening collaborative ties with institutions and organisations that offer training and support for organised research activities in practice settings.

Authors' contributions

ME is the principal investigator of the study. NE, LF, SK and ME conceptualised the study and developed the online surveys. NE, LF, SK, DL and ME developed the interview guides. NE, LF and SK are responsible for the study logistics. JK provided input to the analysis strategy. NE, LF, SK and ME contributed to the first draft of the manuscript. All authors made substantial contributions to subsequent drafts and approved the final manuscript.

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Competing interests statement

None declared.

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Figure 1: Overview of the COVID-19 PedCare Study: objectives and study parts

To enable a comprehensive assessment of the utilisation and provision of paediatric primary care services, the COVID-19 PedCare study uses a convergent mixed-methods design comprising quantitative online surveys and semi-structured interviews and integrates the perspectives of parents, adolescents and primary care paediatricians. ORIC, organisational readiness for implementing change; COVID-19, coronavirus disease 2019.

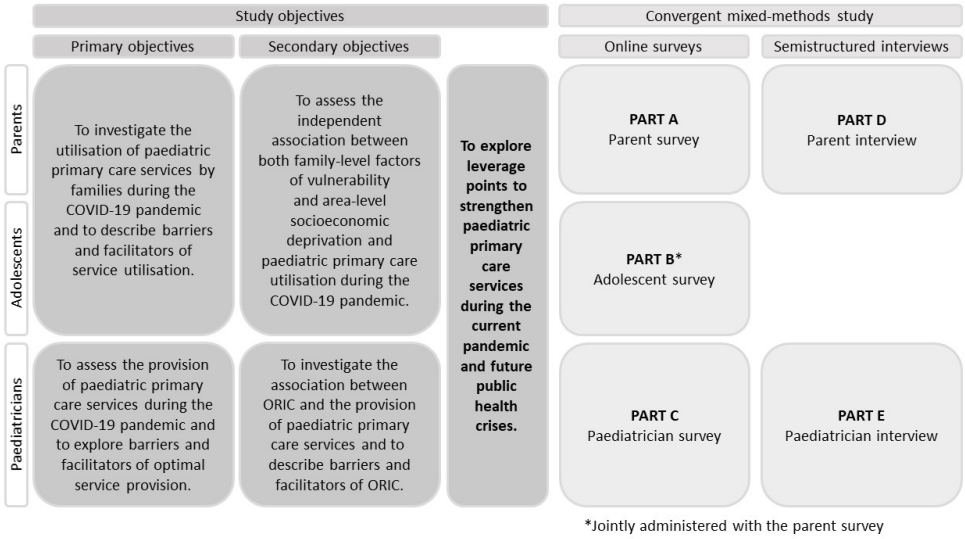

Figure 1: Overview of the COVID-19 PedCare Study - Objectives and study parts

To enable a comprehensive assessment of the utilisation and provision of paediatric primary care services the COVID-19 PedCare study uses a convergent mixed-methods design comprising quantitative online surveys and semistructured interviews and integrates the perspectives of parents, adolescents and primary care paediatricians. ORIC, organisational readiness for implementing change; COVID-19, coronavirus disease 2019.

338x190mm (96 x 96 DPI)

Online supplementary appendices

Appendix 1: Content of the parent and adolescent surveys – items adapted from other studies and items developed for the present study

(1) Utilisation of paediatric primary care services

(1.A) Deferral and cancellation of different types of paediatric primary care services

Please remember the time since the beginning of the COVID-19 pandemic:
Apart from your visit today, were there any reasons to visit a paediatrician with your child?

- Yes
- No

if *Yes:*
Did you then visit the paediatrician?

- Yes, always
- Yes, sometimes
- No

if *Yes, sometimes* or *No*:
Which of the following examinations/treatments did you postpone or cancel during the pandemic?
Please tick all that apply.

- Examination/treatment due to an acute illness
- Routine examination or check-up due to a chronic illness
- Vaccination
- Routine child health check-up ("U-Untersuchung")
- Other examinations: _____

(2) Utilisation of telemedical services

(2.A) Utilisation of different types of telemedical services before and during the COVID-19 pandemic

Which of the following telemedical services did you use to contact your paediatrician before the COVID-19 pandemic began?
Please tick all that apply.

- Video consultation
- Telephone consultation
- E-mail/online chat
- Telemonitoring (e.g. transmission of blood sugar values from patients to paediatricians)
- Keeping a digital diary of symptoms (e.g. of headaches or abdominal pain) and transmitting the data to the paediatrician
- Other: _____

Which of the following telemedical services have you used for the first time since the beginning of the COVID-19 pandemic to contact your paediatrician?
Please tick all that apply.

- Video consultation
- Telephone consultation
- E-mail/online chat
- Telemonitoring (e.g. transmission of blood sugar values from patients to paediatricians)

- Keeping a digital diary of symptoms (e.g. of headaches or abdominal pain) and transmitting the data to the paediatrician
- Other: _____

(3) Correlates of paediatric primary care utilisation

(3.A) Concerns about visiting the paediatric primary care practice

Since the beginning of the COVID-19 pandemic, what are your concerns when visiting a paediatrician?
Free-text question

Since the beginning of the COVID-19 pandemic, have you been more or less concerned about visiting a paediatrician with your child than before the pandemic?

- Much more
- Somewhat more
- The same
- Somewhat less
- Much less

When thinking back on the visits to your paediatrician since the beginning of the COVID-19 pandemic: To what extent do you agree with the following statements?
Fully agree - rather agree - neither agree nor disagree - rather disagree - disagree completely

- I am worried that we could be infected with COVID-19 in the paediatrician's office.
- I am worried that a visit to the paediatrician's office will not be welcome unless it is an emergency.
- I think that the doctor is currently needed more urgently by other children.
- I think the government's recommendations mean that we should not visit the paediatrician's office.
- I am worried that the office is extremely busy and we have to wait a very long time.
- I don't own a car and don't like to use public transport.

(3.B) Sense of security in paediatric primary care practice

How safe do you feel regarding the risk of infection when you visit your paediatrician's office with your child during the COVID-19 pandemic?

- Very safe
- Safe
- Neutral
- Unsafe
- Very unsafe

(3.C) Perceived implementation of infection control measures in paediatric primary care practice

Are the infection prevention measures in your paediatrician's office sufficient in your opinion?

- Absolutely sufficient
- Rather sufficient
- Rather insufficient
- Absolutely insufficient

(3.D) Personal experiences related to the pandemic

Are there people in your household at risk for COVID-19 (e.g. elderly people, people with pre-existing conditions)?

- Yes

- No
- I don't know

What situations applied to you or any other person in your household since the beginning of the COVID-19 pandemic?
Please tick all that apply.

- Preventive self-isolation due to a chronic disease/pre-existing condition
- Quarantine due to suspicion of COVID-19 infection
- Quarantine due to confirmed COVID-19 infection
- Quarantine due to contact with a person with suspected or confirmed COVID-19 infection
- Quarantine after having stayed in a COVID-19 risk area
- Hospitalisation due to confirmed COVID-19 illness

(3.E) Fear of child's infection with COVID-19

Are you concerned that your child could be infected with COVID-19?

- Not worried at all
- A little worried
- Moderately worried
- Rather worried
- Very worried

How bad do you think the disease will be if your child is infected with COVID-19?

- Not bad at all
- Not so bad
- Moderately bad
- Quite bad
- Very bad

(3.F) Reasons for not using telemedical services

If no telemedical services are or were used:
Why don't you use telemedical services?
Please tick all that apply.

- My paediatrician's office does not offer telemedical services.
- I don't have the necessary technical equipment (e.g. laptop, computer).
- I don't have reliable and fast internet access.
- I don't have the necessary technical skills to use telemedical services.
- I am missing the personal contact with the paediatrician when using telemedical services.
- In my opinion, the use of telemedical services is associated with a lower quality of care.
- I have privacy concerns when using telemedical services.
- I encounter communication problems when using telemedical services (e.g. limited knowledge of German).
- Other reasons: _____

(4) Leverage points for strengthening paediatric primary care

(4.A) Possibilities to facilitate carefree consultations at paediatric primary care practices during the COVID-19 pandemic

What would have to change in order for you to be able to visit a paediatrician without any concerns during the COVID-19 pandemic?
Free-text question

(7) Sociodemographic characteristics

(7.A) Child age

Please state the age of your child:
If your child is under one year of age, please enter 0 years.
___ year(s)

(7.B) Child gender
Please state the gender of your child:
- Female
- Male

(7.C) Migration background
What was your nationality at birth?
German, Afghan, Bosnian, Bulgarian, Chinese, French, Greek, Iraqi, Italian, Kosovar, Croatian, Austrian, Polish, Portuguese, Romanian, Russian, Serbian, Spanish, Syrian, Turkish, Hungarian, Dual nationality, Other

What was the nationality of the other parent at birth?
German, Afghan, Bosnian, Bulgarian, Chinese, French, Greek, Iraqi, Italian, Kosovar, Croatian, Austrian, Polish, Portuguese, Romanian, Russian, Serbian, Spanish, Syrian, Turkish, Hungarian, Dual nationality, Other, I don't know

What was the nationality of your child at birth?
When answering questions about your child, please remember to answer for the child with whom you are visiting your paediatrician today. If you are visiting with several children, please answer for the oldest child.
German, Afghan, Bosnian, Bulgarian, Chinese, French, Greek, Iraqi, Italian, Kosovar, Croatian, Austrian, Polish, Portuguese, Romanian, Russian, Serbian, Spanish, Syrian, Turkish, Hungarian, Dual nationality, Other

(7.D) Parent age
Please state your age:
- < 20 years
- 20 – 29 years
- 30 – 39 years
- 40 – 49 years
- 50 – 59 years
- ≥ 60 years

(7.E) Parent gender
Please state your gender:
- Female
- Male

(7.G) Single parent
Are you a single parent?
- Yes
- No

Appendix 2: Content of the paediatrician survey – items adapted from other studies and items developed for the present study

(1) Provision of paediatric primary care services

(1.A) Deferral and cancellation of different types of paediatric primary care services

Have you postponed or cancelled any consultations since the COVID-19 pandemic began?

- No
- Yes

If *Yes*:

Which of the following examinations/treatments did you postpone or cancel during the pandemic?

Please tick all that apply.

- Examinations/treatments due to an acute illness
- Routine examinations or check-ups due to a chronic illness
- Routine child health check-ups ("U-Untersuchungen")
- Vaccinations
- Other examinations: _____

Did your practice have to close temporarily due to the COVID-19 pandemic?

- No
- Yes

If *Yes*:

- Yes, ____ weeks

(1.B) Change in opening hours

Have the opening hours of your practice changed since the start of the COVID-19 pandemic?

- No
- Yes

If *Yes*:

To what extent have the opening hours of your practice changed since the start of the COVID-19 pandemic?

Please tick all that apply.

- Currently reduced opening hours
- Currently extended opening hours
- Temporarily reduced opening hours in the past (e.g. during lockdown)
- Temporarily extended opening hours in the past (e.g. during lockdown)

If *Yes*:

For what reasons have you changed your regular opening hours?

Please tick all that apply.

- Staff shortage due to sick leave
- Staff shortage due to quarantine of employees
- Staff shortage due to preventive measures (e.g. risk groups staying away from the workplace)
- Staff shortage due to obligations caring for children or relatives
- Higher administrative workload than before the start of the COVID-19 pandemic
- Infection control measures could not be implemented with regular opening hours
- More patients than at the same time last year

- Fewer patients than at the same time last year
- Personal reasons
- Other reasons: _____

(1.C) Provision of COVID-19-specific services

How many COVID-19 smears do you currently take per day on average?

- < 5 smears/day
- 5 – 9 smears/day
- 10 – 14 smears/day
- 15 – 19 smears/day
- ≥ 20 smears/day

How many certificates do you currently issue on average per day in connection with the COVID-19 pandemic (e.g. at the request of kindergartens or schools)?

- < 5 certificates/day
- 5 – 9 certificates/day
- 10 – 14 certificates/day
- 15 – 19 certificates/day
- ≥ 20 certificates/day

(2) Provision of telemedical services

(2.A) Provision of different types of telemedical services before and during the COVID-19 pandemic

Do you use telemedical services in your practice?

- Yes
- No, but the use is being prepared
- No, I won't use it in a foreseeable time

If *Yes*:

Which of the following telemedical services did you use before the COVID-19 pandemic began?

Please tick all that apply.

- Video consultation
- Telephone consultation
- E-mail/online chat
- Telemonitoring (e.g. transmission of blood sugar values from patients to paediatricians)
- Keeping a digital diary of symptoms (e.g. of headaches or abdominal pain) and transmitting the data to the paediatrician
- Other: _____

If *Yes*:

Which of the following telemedical services have you used for the first time since the beginning of the COVID-19 pandemic?

Please tick all that apply.

- Video consultation
- Telephone consultation
- E-mail/online chat
- Telemonitoring (e.g. transmission of blood sugar values from patients to paediatricians)
- Keeping a digital diary of symptoms (e.g. of headaches or abdominal pain) and transmitting the data to the paediatrician
- Other: _____

If *No, but the use is being prepared*:
Which of the following telemedical services is your practice currently preparing to use?
Please tick all that apply.

- ○ Video consultation
- ○ Telephone consultation
- ○ E-mail/online chat
- ○ Telemonitoring (e.g. transmission of blood sugar values from patients to paediatricians)
- ○ Keeping a digital diary of symptoms (e.g. of headaches or abdominal pain) and transmitting the data to the paediatrician
- ○ Other: _____

If *Yes*:
What proportion of patient consultations did you handle via telemedical services before the COVID 19 pandemic, i.e. before March 2020?
Please estimate the proportion.

- ○ 0%
- ○ 1% - 4%
- ○ 5% - 9%
- ○ 10% - 49%
- ○ ≥ 50%

If *Yes*:
What proportion of patient consultations have you handled via telemedical services in the last 4 weeks?
Please estimate the proportion.

- ○ 0%
- ○ 1% - 4%
- ○ 5% - 9%
- ○ 10% - 49%
- ○ ≥ 50%

(3) Infection control measures implemented in paediatric primary care practices

(3.A) Implementation of infection control measures in paediatric primary care practices

Which of the following infection control measures are being implemented in your practice due to the COVID-19 pandemic?
Yes - no, as not useful - no, but would be useful

- ○ Consultation by appointment only
- ○ Parents and children wait outside the practice prior to the consultation.
- ○ Measures to ensure distancing between families in the practice (e.g. floor marking for queues, reduced number of chairs in the waiting room)
- ○ Consistent enforcement of mask-wearing for parents
- ○ Consistent enforcement of mask-wearing for children and adolescents aged 10 years and older.
- ○ Consistent enforcement of mask-wearing for children 6 – 9 years of age
- ○ Consistent enforcement of mask-wearing for children below 6 years of age
- ○ Consistent enforcement of mask-wearing for practice staff
- ○ Separate consulting hours for children with symptoms consistent with COVID-19 infection (e.g. infection consultations) and children with other conditions (e.g. vaccination or screening consultations)

- Spatial separation between children with symptoms compatible with COVID-19 infection and children with other complaints (e.g. use of an "infection room" or "infection area")
- Additional hygiene measures for parents and children (e.g. hand disinfection or hand washing after entering the practice)
- Implementation of additional disinfection measures after each patient contact
- Structural measures to protect against infection (e.g. installation of physical barriers at reception desks)
- Use of personal protective equipment during physical examinations of children and adolescents with symptoms of infection
- Use of personal protective equipment when taking nasopharyngeal swabs
- Implementing screening measures among staff
- Regular airing of the practice rooms

What other infection control measures are being implemented in your practice due to the COVID-19 pandemic?
Free-text question

What other infection control measures should be implemented in your practice beyond the existing measures?
Free-text question

Do you need support to implement appropriate infection control measures in your practice in the coming months?
- Yes
- No

If *Yes*:
What support do you need?
Free-text question

(4) Correlates of paediatric primary care service provision

(4.A) Factors related to the pandemic affecting service provision

How much do the following factors currently affect your daily practice?
Very much – considerably – not so much – not at all
- Staff shortage due to sick leave
- Staff shortage due to quarantine of employees
- Staff shortage due to preventive measures (e.g. risk groups staying away from the workplace)
- Staff shortage due to obligations caring for children or relatives
- Higher administrative workload than before the start of the COVID-19 pandemic
- Time-consuming infection control measures
- Costly infection control measures
- More patients than at the same time last year
- Fewer patients than at the same time last year

(4.B) Reasons for not providing telemedical services

If no telemedical services are or were used:
Why don't you use telemedical services?
Please tick all that apply.
- I don't have the necessary IT infrastructure in practice.

- I don't have reliable and fast internet access.
- I don't have the necessary technical skills to use telemedical services.
- I consider personal contact with patients and parents to be indispensable.
- I don't have the time to establish telemedical services in the practice.
- I don't reach all families with telemedical services.
- There is a lack of demand for telemedical services among families.
- Other reasons: _____

(4.C) Opinion towards telemedical services

To what extent do you agree with the following statements?

Fully agree; rather agree; neither agree nor disagree; rather disagree; disagree completely

- Telemedical services are associated with lower quality of treatment.
- Telemedical care is more time-consuming than care without telemedical services.
- I have data protection concerns about the use of telemedical services.
- Most of the families I care for want telemedical care.
- I would like more support in the use of telemedical services (e.g. in the form of training, information material, technical support).
- I prefer personal contact.

(4.D) Personal experiences related to the pandemic

Which of the following statements apply to you?

Please tick all that apply.

- I myself belong to a risk group for COVID-19 (e.g. due to my age or due to pre-existing conditions).
- I had to (temporarily) reduce or suspend my work in the practice during the COVID-19 pandemic due to childcare obligations or the care of relatives.
- I self-isolated as a precautionary measure due to a chronic disease/pre-existing condition.
- I had to self-isolate because I was suspected of having a COVID-19 infection.
- I had to self-isolate because I had a confirmed COVID-19 infection.
- I had to self-isolate because I had contact with a person with suspected or confirmed COVID-19 infection.
- I had to self-isolate because I had been in a COVID-19 risk area.
- I had to be hospitalised because of a confirmed COVID-19 illness.

(6) Leverage points for strengthening paediatric primary care services

(6.A) Concerns and support needs related to the upcoming months

To what extent do you agree with the following statement?

Fully agree; rather agree; neither agree nor disagree; rather disagree; disagree completely

- As a practising primary care paediatrician, I am worried when I think about the coming months.

If *Fully agree* or *Rather agree*:

What worries you when you think about the coming months?

Free-text question

What support do you need so that you, as a practising paediatrician, can handle the coming months well?

Free-text question

(6.B) Ideas how to improve paediatric primary care services during the COVID-19 pandemic for children and adolescents in general and those with special healthcare needs

What would have to be done so that as many children and adolescents as possible can be cared for adequately in paediatric primary care during the COVID-19 pandemic?
Free-text question

The care of children and adolescents with chronic diseases is an important task of paediatricians in private practice.
What do you think needs to be done to ensure that children and adolescents with chronic diseases can also be cared for adequately during the COVID-19 pandemic?
Free-text question

(7) Aspects of primary care paediatrician health

(7.B) Burden related of the COVID-19 pandemic

To what extent do you agree with the following statements?
Fully agree; rather agree; neither agree nor disagree; rather disagree; disagree completely

- I am worried that I will be infected with COVID-19 at work.
- I am worried that I may infect people around me with COVID-19 because of my work.
- I have changed my socialising and travel patterns because of the COVID-19 pandemic (e.g. I avoid large crowds or public transport).
- The COVID-19 pandemic has led to an increase in my daily workload.
- Due to the COVID-19 pandemic, I have significantly less time for my personal life.
- Since the COVID-19 pandemic, I have been sleeping less well.
- I feel that my work is appreciated by families during the COVID-19 pandemic.
- Since the outbreak of the COVID-19 pandemic, the satisfaction with my job has worsened.
- I feel left alone by the responsible political decision-makers.
- Due to the COVID-19 pandemic I feel mentally strained.
- My everyday life at home has become significantly more stressful due to the COVID-19 pandemic.
- Due to the COVID-19 pandemic, I am worrying more often about the future.
- Due to the COVID-19 pandemic, I am worrying more often about the well-being of my family.
- I feel stressed by the infection control measures in my everyday work.

(8) Sociodemographic and professional characteristics

(8.A) Age

Please state your age:

- < 30 years
- 30 – 39 years
- 40 – 49 years
- 50 – 59 years
- ≥ 60 years

(8.B) Gender

Please state your gender:

- Female
- Male

(8.C) Number and age of own children

The following is about your own children.
Questions about the children and adolescents you care for in your practice can be found further on in the questionnaire.
Do you have children?

- Yes

- No

If *Yes*:
How many children do you have in each of the following age groups?
- 0 – 1 year: ___ child(ren)
- 2 - 5 years: ___ child(ren)
- 6 – 11 years: ___ child(ren)
- 12 - 18 years: ___ child(ren)

(8.D) Subspecialty training
Have you completed a fellowship after finishing paediatric residency?
- Yes
- No
- No, I am still in residency

(8.E) Experience in paediatric primary care
How many years have you been working in outpatient paediatric primary care?
- < 5 years
- 5 – 9 years
- 10 – 19 years
- 20 – 29 years
- 30 – 39 years
- ≥ 40 years

(8.F) Employment status
Do you run your own practice as a self-employed paediatrician or do you work in primary care as an employed doctor?
- Self-employed
- Employed

(8.G) Weekly working hours
How many hours per week do you work in your practice?
- < 10 hours
- 10 – 19 hours
- 20 – 29 hours
- 30 – 39 hours
- 40 – 49 hours
- ≥ 50 hours

(9) Practice characteristics

(9.A) Type of practice
In what type of practice are you currently working?
- Solo practice
- Group practice
- Multispecialty medical care centre
- Other: _____

(9.B) Practice size
How many statutory health insurance claims are processed in your practice per quarter?
- 0 – 299
- 300 – 599
- 600 – 899

- 900 – 1199
- 1200 – 1499
- ≥ 1500

Please estimate the percentage of patients in your practice with private health insurance:
____ %

(9.C) Population of the municipality the paediatric primary care practice is located in

How many inhabitants are there in the municipality/city your practice is located in?

- < 5,000
- 5,000 to < 20,000
- 20,000 to < 50,000
- 50,000 to < 100,000
- 100,000 to < 500,000
- ≥ 500,000

COREQ (COnsolidated criteria for REporting Qualitative research) Checklist

A checklist of items that should be included in reports of qualitative research. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity			
Personal characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	
Occupation	3	What was their occupation at the time of the study?	
Gender	4	Was the researcher male or female?	
Experience and training	5	What experience or training did the researcher have?	
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	
Interviewer characteristics	8	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	
Domain 2: Study design			
Theoretical framework			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	
Participant selection			
Sampling	10	How were participants selected? e.g. purposive, convenience, consecutive, snowball	
Method of approach	11	How were participants approached? e.g. face-to-face, telephone, mail, email	
Sample size	12	How many participants were in the study?	
Non-participation	13	How many people refused to participate or dropped out? Reasons?	
Setting			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	
Data collection			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	
Repeat interviews	18	Were repeat inter views carried out? If yes, how many?	
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	
Field notes	20	Were field notes made during and/or after the inter view or focus group?	
Duration	21	What was the duration of the inter views or focus group?	
Data saturation	22	Was data saturation discussed?	
Transcripts returned	23	Were transcripts returned to participants for comment and/or	

Topic	Item No.	Guide Questions/Description	Reported on Page No.
		correction?	
Domain 3: analysis and findings			
Data analysis			
Number of data coders	24	How many data coders coded the data?	
Description of the coding tree	25	Did authors provide a description of the coding tree?	
Derivation of themes	26	Were themes identified in advance or derived from the data?	
Software	27	What software, if applicable, was used to manage the data?	
Participant checking	28	Did participants provide feedback on the findings?	
Reporting			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	
Data and findings consistent	30	Was there consistency between the data presented and the findings?	
Clarity of major themes	31	Were major themes clearly presented in the findings?	
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	

Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

Once you have completed this checklist, please save a copy and upload it as part of your submission. DO NOT include this checklist as part of the main manuscript document. It must be uploaded as a separate file.

Checklist for Reporting Results of Internet E-Surveys (CHERRIES)

Checklist Item	***Explanation***	***Page Number***
Describe survey design	Describe target population, sample frame. Is the sample a convenience sample? (In "open" surveys this is most likely.)	7 - 8
IRB approval	Mention whether the study has been approved by an IRB.	21
Informed consent	Describe the informed consent process. Where were the participants told the length of time of the survey, which data were stored and where and for how long, who the investigator was, and the purpose of the study?	21
Data protection	If any personal information was collected or stored, describe what mechanisms were used to protect unauthorized access.	10
Development and testing	State how the survey was developed, including whether the usability and technical functionality of the electronic questionnaire had been tested before fielding the questionnaire.	10-11 and 15
Open survey versus closed survey	An "open survey" is a survey open for each visitor of a site, while a closed survey is only open to a sample which the investigator knows (password-protected survey).	8
Contact mode	Indicate whether or not the initial contact with the potential participants was made on the Internet. (Investigators may also send out questionnaires by mail and allow for Web-based data entry.)	7-8
Advertising the survey	How/where was the survey announced or advertised? Some examples are offline media (newspapers), or online (mailing lists – If yes, which ones?) or banner ads (Where were these banner ads posted and what did they look like?). It is important to know the wording of the announcement as it will heavily influence who chooses to participate. Ideally the survey announcement should be published as an appendix.	7-8
Web/E-mail	State the type of e-survey (eg, one posted on a Web site, or one sent out through e-mail). If it is an e-mail survey, were the responses entered manually into a database, or was there an automatic method for capturing responses?	7-10
Context	Describe the Web site (for mailing list/newsgroup) in which the survey was posted. What is the Web site about, who is visiting it, what are visitors normally looking for? Discuss to what degree the content of the Web site could pre-select the sample or influence the results. For example, a survey about vaccination on a anti-immunization Web site will have different results from a Web survey conducted on a government Web site	Not applicable
Mandatory/voluntary	Was it a mandatory survey to be filled in by every visitor who wanted to enter the Web site, or was it a voluntary survey?	Not applicable
Incentives	Were any incentives offered (eg, monetary, prizes, or non-monetary incentives such as an offer to provide the survey results)?	9

Time/Date	In what timeframe were the data collected?	7
Randomization of items or questionnaires	To prevent biases items can be randomized or alternated.	10
Adaptive questioning	Use adaptive questioning (certain items, or only conditionally displayed based on responses to other items) to reduce number and complexity of the questions.	9
Number of Items	What was the number of questionnaire items per page? The number of items is an important factor for the completion rate.	9-10
Number of screens (pages)	Over how many pages was the questionnaire distributed? The number of items is an important factor for the completion rate.	Not applicable
Completeness check	It is technically possible to do consistency or completeness checks before the questionnaire is submitted. Was this done, and if "yes", how (usually JAVAScript)? An alternative is to check for completeness after the questionnaire has been submitted (and highlight mandatory items). If this has been done, it should be reported. All items should provide a non-response option such as "not applicable" or "rather not say", and selection of one response option should be enforced.	10
Review step	State whether respondents were able to review and change their answers (eg, through a Back button or a Review step which displays a summary of the responses and asks the respondents if they are correct).	10
Unique site visitor	If you provide view rates or participation rates, you need to define how you determined a unique visitor. There are different techniques available, based on IP addresses or cookies or both.	Not applicable
View rate (Ratio of unique survey visitors/unique site visitors)	Requires counting unique visitors to the first page of the survey, divided by the number of unique site visitors (not page views!). It is not unusual to have view rates of less than 0.1 % if the survey is voluntary.	Not applicable
Participation rate (Ratio of unique visitors who agreed to participate/unique first survey page visitors)	Count the unique number of people who filled in the first survey page (or agreed to participate, for example by checking a checkbox), divided by visitors who visit the first page of the survey (or the informed consents page, if present). This can also be called "recruitment" rate.	Not applicable
Completion rate (Ratio of users who finished the survey/users who	The number of people submitting the last questionnaire page, divided by the number of people who agreed to participate (or submitted the first survey page). This is only relevant if there is a separate "informed consent" page or if the survey goes over several pages. This is a measure for attrition. Note that	Not applicable

agreed to participate)	"completion" can involve leaving questionnaire items blank. This is not a measure for how completely questionnaires were filled in. (If you need a measure for this, use the word "completeness rate".)	
Cookies used	Indicate whether cookies were used to assign a unique user identifier to each client computer. If so, mention the page on which the cookie was set and read, and how long the cookie was valid. Were duplicate entries avoided by preventing users access to the survey twice; or were duplicate database entries having the same user ID eliminated before analysis? In the latter case, which entries were kept for analysis (eg, the first entry or the most recent)?	10
IP check	Indicate whether the IP address of the client computer was used to identify potential duplicate entries from the same user. If so, mention the period of time for which no two entries from the same IP address were allowed (eg, 24 hours). Were duplicate entries avoided by preventing users with the same IP address access to the survey twice; or were duplicate database entries having the same IP address within a given period of time eliminated before analysis? If the latter, which entries were kept for analysis (eg, the first entry or the most recent)?	10
Log file analysis	Indicate whether other techniques to analyze the log file for identification of multiple entries were used. If so, please describe.	Not applicable
Registration	In "closed" (non-open) surveys, users need to login first and it is easier to prevent duplicate entries from the same user. Describe how this was done. For example, was the survey never displayed a second time once the user had filled it in, or was the username stored together with the survey results and later eliminated? If the latter, which entries were kept for analysis (eg, the first entry or the most recent)?	10
Handling of incomplete questionnaires	Were only completed questionnaires analyzed? Were questionnaires which terminated early (where, for example, users did not go through all questionnaire pages) also analyzed?	20
Questionnaires submitted with an atypical timestamp	Some investigators may measure the time people needed to fill in a questionnaire and exclude questionnaires that were submitted too soon. Specify the timeframe that was used as a cut-off point, and describe how this point was determined.	Not applicable
Statistical correction	Indicate whether any methods such as weighting of items or propensity scores have been used to adjust for the non-representative sample; if so, please describe the methods.	Not applicable

This checklist has been modified from Eysenbach G. Improving the quality of Web surveys: the Checklist for Reporting Results of Internet E-Surveys (CHERRIES). J Med Internet Res. 2004 Sep 29;6(3):e34 [erratum in J Med Internet Res. 2012; 14(1): e8.]. Article available at https://www.jmir.org/2004/3/e34/; erratum available https://www.jmir.org/2012/1/e8/. Copyright ©Gunther Eysenbach. Originally published in the Journal of Medical Internet Research, 29.9.2004 and 04.01.2012.