



# Mobile Apps for Sexual and Reproductive Health Education: a Systematic Review and Quality Assessment

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## Abstract

**Purpose of Review** The aim of this study was to present the current state of research on mobile health apps for sexual and reproductive health (SRH) education. Apps were analysed based on contents (by using the World Health Organization's SRH framework), features, intended audiences and quality of evidence (by applying the *Grading of Recommendations Assessment, Development and Evaluation* (GRADE) approach). Taking German sexuality education apps as an example, the rapid development in the field of SRH apps over the last 3 years has been revealed by comparing the quality of apps available in 2019 with apps from 2022.

**Recent Findings** SRH apps allow health information to be disseminated quickly, at low thresholds and in a practical and cost-effective manner. Moreover, they allow for anonymous usage independently of time and place. In the absence of network coverage, offline use is also possible. Previous research focused on individual SRH aspects (e.g. human immunodeficiency virus (HIV), contraception). However, some studies were designed to cover a broader range of SRH topics, but identified only a few relevant apps.

**Summary** To improve SRH, it would be helpful if the apps would be of high-quality design and be made up of relevant content. Furthermore, they should be tailored to the target group and have been tested in real-life settings. A total of 50 SRH apps with sufficiently high-quality ratings were included. The apps cover a variety of SRH topics, but they often lack field-based evaluation. The effectiveness of SRH apps has not yet been sufficiently studied in a scientific manner. Only 9 apps were deemed to be adequate for a moderate GRADE level. Despite this grading, the study nevertheless shows that there are several apps that could potentially promote SRH.

**Keywords** Mhealth · Sex education · Sexual health · Reproductive health · Smartphone apps · Systematic review

## Abbreviations

GRADE	The Grading of Recommendations Assessment, Development and Evaluation
HIV	Human immunodeficiency virus
MARS, MARS-G	The Mobile Application Rating Scale, Mobile Anwendungen Rating Skala
mHealth	Mobile health
MSM	Men who have sex with men
RCT	Randomised controlled trials
SRH	Sexual and reproductive health

STI	Sexual transmitted infection
WHO	The World Health Organization

## Introduction

To facilitate interactions between physicians and patients, the use of a health app such as *Babyscripts* might be helpful. Besides providing pregnancy information the *Babyscripts* app also allows pregnant persons to communicate with their doctors. Furthermore, the application is linked to remote monitoring devices. If any deviating parameters are detected, the app assists by alerting nurses and patients [1•, 2, 3].

Sexual minorities can also benefit from health apps that are tailored to meet their needs [4]. One example is the *myPEEPS* app. With interactive components such as gamifications (e.g. quizzes), scenarios as well as role plays, it aims to provide same-sex attracted young males with helpful

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knowledge and skills to reduce their sexual risk behaviour and the risk of them contracting a sexual transmitted infection (STI) [5–8].

This study focuses on health apps as a specific type of mobile health (mHealth) interventions. mHealth interventions, i.e. interventions delivered via mobile devices, can successfully improve people's health [9]. Compared to conventional interventions, people benefit from mHealth by being enabled to quickly access information at low thresholds and independently of time and place as well as at low cost [9–14]. mHealth interventions can also meet the need for anonymity, which is especially crucial when it comes to sexuality [4, 14, 15].

Health apps can be used to disseminate health information effectively, practically and cost-effectively via mobile phones or tablets [10–13, 16]. Another advantage of native apps in comparison to other mHealth interventions is the possible offline use in the absence of network coverage [4]. In addition to common text message interventions [9], a variety of interactive features can be implemented in apps to positively influence people's health.

This article is based on the current *World Health Organization* (WHO) definition of sexual health [17]. Therefore, apps that focus on aspects such as sexual well-being are being additionally considered to more conventional topics of sexual health like prevention of human immunodeficiency virus (HIV) or sexual risk behaviours. *Sexual and reproductive health* [18, 19] are closely intertwined [20]. Hence, this study also covers apps that focus mainly on reproductive aspects. For analysing *sexual and reproductive health* (SRH) aspects, a WHO-framework that distinguishes eight domains of SRH and four socio-structural aspects is used [20].

To promote SRH, apps can provide fundamental knowledge through playful elements (e.g. quizzes) [21–23]. Self-assessment and tracking options for symptoms, the menstrual cycle or fertility biomarkers (e.g. basal body temperature, cervical fluid) are other important features of SRH apps [22, 24, 25]. Users can often get their questions answered through the app (FAQs, chatbots, interactive components) [21, 26]. Furthermore, an important element of some apps is the references to offline help services or in-app contact options to experts [21, 24].

## Aim of the Review

Current app research often focuses on individual SRH aspects (e.g. HIV, pregnancy prevention) [24, 27, 28]. Other studies already include a wider range of SRH topics but only identify a few relevant apps [29, 30, 31•]. The aim of this study was to present the most researched SRH apps and evaluate their characteristics and outcomes. To identify the apps and the evidence available about them, two types of

publications were used: *literature reviews* (i.e. papers summarising research on mHealth solutions) and *app reviews* (i.e. papers presenting apps available on common app platforms). Taking German sex education apps as an example, the rapid development in the field of SRH apps is shown.

## Methods

The study was conducted in two steps: (1) a systematic literature search to identify SRH apps known in the scientific community followed by (2) an analysis of the selected SRH apps in terms of contents, features, intended audiences and quality of evidence.

### Literature Search

The following databases were searched: Pubmed, Embase, PsycInfo, PSYINDEX, PsycArticle, CINAHL, Web of Science, Cochrane Reviews and Cochrane Trials. For this purpose, studies were searched that contained an *SRH component* (e.g. sexual health, sexual well-being, reproductive health, reproductive well-being) and an *app component* (e.g. app, application, mobile phone) in *title or abstract*. The study presents systematic reviews and meta-analysis limited to publications of the *last 5 years* due to the rapid change in availability of apps [10, 21, 32, 33]. Studies were *included* if they (a) focused on or addressed SRH components, (b) included smartphone or tablet apps and (c) were written in English or German. On the other side, studies were *excluded* if they (a) focused on other health-related topics (e.g. mental health) or (b) included other mHealth interventions (e.g. SMS interventions) without mentioning apps or (c) interventions via other apps (e.g. Social Media Platforms). After duplicates removed, 315 studies were screened by title and abstract (for details on study identification, see Appendix 1). By screening all reference lists of included studies, 8 additional studies were identified. Finally, 25 systematic reviews were included in the analysis. In some of the included literature reviews, study protocols of randomised controlled trials (RCT) or articles with ongoing RCTs were mentioned [7, 34–36]. In these cases, an additional search for published studies on particular apps was conducted [37–46].

### App Analysis

Apps that achieved at least acceptable quality ratings or were recommended by the study authors were included (for details, see Appendix 2). Apps were analysed with focus on contents, features, intended audiences and quality of evidence. In order to compare findings across studies, the *Grading of Recommendations Assessment, Development and Evaluation* (GRADE) Approach proposed by the *GRADE*

*Working Group* was used to assess whether the quality of evidence for each app was (a) high, (b) moderate, (c) low or (d) very low [47].

## Results

### Literature Search

In the analysis, 25 systematic review studies were included. Two types of studies stood out: *literature reviews* [1•, 5, 24, 27–30, 31•, 48•, 49, 50••, 51••, 52–54, 55••, 56, 57] and *app reviews* (i.e. evaluations of apps available in common app stores) [1•, 5, 23–26, 28, 32, 33, 58, 59]. Twelve studies covered digital and mobile health interventions in general [27–30, 31•, 51••, 52–54, 55••, 56, 57], and 13 focused specifically on health apps [1•, 5, 23–26, 32, 33, 48•, 49, 50••, 58, 59]. Most studies focused on SRH with only a few [50••, 56, 57] examining general health interventions.

**Studied SRH Topics** Sexual health areas were covered by 15 studies: (a) comprehensive education and information [23, 28–30, 31•, 33, 52, 54, 59], (b) gender-based violence prevention, support and care [29, 31•, 52, 53, 55••], (c) prevention and control of HIV and other STIs [5, 27, 29, 30, 31•, 51••, 52, 55••] and (d) sexual function and psychosexual counselling [24, 28, 51••, 54]. Areas that have a reproductive character: (e) antenatal, intrapartum and postnatal care [1•, 26, 29, 53, 55••], (f) contraception counselling and provision [5, 29, 31•, 32, 48•, 49, 52], (g) fertility care [25, 26, 29, 30, 31•, 32, 33, 48•, 49, 52, 55••, 58] and safe abortion care [29, 30, 31•, 55••] were also covered by 15 studies. In the field of reproductive health, a large proportion of the studies dealt with fertility care (especially menstrual monitoring). Social-structural factors were rarely an explicit topic of the studies. Three studies considered cultural and social norms around sexuality [5, 29, 51••], five studies gender and socioeconomic inequalities [29, 30, 31•, 52, 55••] and two studies human rights [29, 30].

**Studied Populations** The vast majority of studies focused on (a) women [25, 32, 33, 48•, 49, 52, 58] or more specifically, pregnancy and the postpartum period [26, 29]. Other studies concentrated on (b) children [23, 29], adolescents and young people [23, 29, 30, 31•, 50••, 59], (c) men [28] or men who have sex with men (MSM) [5] and (d) healthcare workers and/or patients [1•, 27]. There were also studies conducted on (e) adults [24, 54] and (f) people that were deemed healthy [56] as well as (g) people in general [51••, 53, 55••, 57].

**Identification of SRH Apps** No apps were included if studies (a) addressed digital interventions, but did not contain

apps [30, 54] or (b) did not name individual apps [28, 33]. Furthermore, if (c) study authors did not recommend any app [58] or (d) no quality assessment was conducted in the study [24] apps were also not included (see Appendix 2 for information on the studies and the selection criteria for the apps included in the analysis).

### SRH Apps

In terms of contents, technical aspects (features), intended audiences as well as quality of evidence 50 apps were analysed (see Table 1 for details and short summaries of relevant findings on each app).

**Contents of SRH Apps** Nine apps focused on (a) *comprehensive education and information*, 3 on (b) *gender-based violence prevention, support and care*, 9 on (c) *prevention and control of HIV and other STIs* and only one on (d) *sexual function and psychosexual counselling*. Covered by 12 apps was (e) *antenatal, intrapartum and postnatal care*. There were 9 apps on the topic (f) *contraception counselling and provision* and 20 on (g) *fertility care* (including tracking-apps). No app focussing on (h) *safe abortion care* could be found. Four apps addressed *cultural and social norms around sexuality*, among these one was noted to be transformative on gender relations [55••]. The remaining social-structural factors may have been approached indirectly (e.g. gender inequalities can be addressed in gender-based violence prevention apps), but they were not the main app contents or explicit research subjects. Figure 1 shows the distribution of contents according to GRADE levels and intended audience groups.

**Features of SRH Apps** Many apps ( $n=31$ ) offer different data collection options for users e.g. self-tracking menstruation, managing symptoms by taking notes or in some cases collecting data through other devices via Bluetooth [2, 3, 60]. Educational information was also provided in many ( $n=19$ ) apps. Reminders or push notifications were a feature which 16 apps contained. A few apps featured audio ( $n=5$ ) or video ( $n=4$ ) content and used gamification ( $n=4$ ) or interactive components ( $n=4$ ). Some also enabled communication with experts via app ( $n=9$ ), provided an FAQ section ( $n=6$ ), supported decision-making ( $n=6$ ) or had a community section for social support (e.g. forum,  $n=4$ ). Sharing data between client and healthcare workers was possible in 3 apps. Only 2 apps mentioned offline care services.

**Intended Audiences of SRH Apps** The included apps addressed four target groups: (a) women, (b) children, adolescents and young adults, (c) healthcare workers and/or patients and (d) men. They are presented in Table 1, which

Table 1 SRH apps

#	App name	S/T	ctry	lang	Intended audience	SRH topics	Features	GRADE	Study aims	Findings	Studies
<i>SRH apps for women</i>											
1	AKUD	S	DE	de	Women	g	1, 2, 5, 9	Moderate	E	Decrease in menstrual pain	Review: Earle et al. (2021) [48•] Original study: Blödt et al. (2018) [87]
2	ClearBlue	S	UK	n/a	Women	g	2	Moderate	E	Increased likelihood of conceiving within two menstrual cycles Some of the study authors may have competing interests [60]	Review: Ford et al. (2022) [49] Original study: Johnson et al. (2020) [60]
3	myPlan	S	KE	local languages	Women at risk and survivors of IPV	b	1, 2, 4, 13	Moderate	F, A, E	Increased women's knowledge on safety and rights concerning IPV; enhanced feelings of confidence and resilience; enabled women to make informed decisions related to their safety, mitigate violence and deescalate potentially harmful situations with their partners	Review: Kirkwood et al. (2022) [55••] Original study: Decker et al. (2020) [88]
4	Plan A Birth Control	T	USA	en	Women	f	1	Moderate	E	Did not adversely affect highly effective birth control uptake. App can save time for physicians and health educators if used as an adjunct to contraception counselling in waiting room settings	Review: Ford et al. (2022) [49] Original study: Sridhar et al. (2015) [61]
5	Pulse	S	USA	en	Black and Latina young women (18 to 20 y)	a, b, c, f	4, 5, 6, 7, 9, 12	Moderate	D, E	Increase in knowledge regarding contraception, HIV and/or STIs; decrease in reports of having sex without contraception	Review: Chandler et al. (2022) [52] Original study: Manlove et al. (2020) [89]
6	Cycle Beads	S	KE, EG, GH, IN, JO, KE, NG, RW	en, fr, es, ar, tr, hi	Women	f, g	2	Low	F	Can be easily distributed at low cost, has the potential to expand access to fertility-based awareness methods, can address multiple reproductive intentions Some of the study authors may have competing interests [74]	Reviews: Earle et al. (2021) [48•], Ford et al. (2022) [49], Kirkwood et al. (2022) [55••] Original studies: Shelus et al. (2017) [73], Haile et al. (2018) [74]

Table 1 (continued)

#	App name	S/T	ctry	lang	Intended audience	SRH topics	Features	GRADE	Study aims	Findings	Studies
7	Dot App	S	USA	n/a	Women	f, g	2	Low	E	Effective for pregnancy prevention, most women are able to use it successfully according to their intention to prevent pregnancy Fowler et al. (2020) noted that the apps at least required college-level education (Readability and Accessibility of Terms of Service and Privacy Policies) [73] Some of the study authors may have competing interests [75, 76]	Reviews: Earle et al. (2021) [48], Ford et al. (2022) [49], Fowler et al. (2020) [58] Original studies: Li et al. (2016) [75], Jennings et al. (2019) [76]
8	DOVE	T	USA	n/a	PPP	b	1, 2, 6	Low	F, A	Can be used as a tool for initiating discussion about IPV, assisting women in enhancing their safety and exploring help-seeking options. Training for home visitors is required	Review: El Morr et al. (2020) [53] Original study: Baechus et al. (2016) [72]
9	Health-E-You	T	USA	en	Female adolescents	f	1, 4, 5, 6	Low	D, U, F, A, E	Increase in sexual health knowledge on contraceptive options; influenced adolescents' intentions to use an effective or more effective method of contraception	Reviews: Earle et al. (2021) [48], Ford et al. (2022) [49] Original study: Meshri-akova and Tebb (2017) [86]
10	Luna Luna	S	JP	n/a	Women	g	1, 2	Low	D	Clarified how data obtained Luna Luna can be used to improve the accuracy of prediction of the date of next ovulation Some of the study authors may have competing interests [77]	Reviews: Earle et al. (2021) [48], Ford et al. (2022) [49] Original study: Sohda et al. (2017) [77]
11	MEMPHIS	S	UK	en	Women with chronic pelvic pain	d	1, 5	Low	F	There was low adherence for regular use of the application. Results showed ineffectiveness compared to the control group (usual pain management treatment)	Review: Jurin et al. (2022) [24] Original study: Forbes et al. (2020) [78]

Table 1 (continued)

#	App name	S/T	ctry	lang	Intended audience	SRH topics	Features	GRADE	Study aims	Findings	Studies
12	Mobile Midwife	S	GH	local languages	PPP, parents/caregivers, pregnant and nursing mothers (20 to 35 y)	e	1, 9	Very low	A, E	Increased seeking essential obstetric care. Participants felt strengthened in their understanding of the importance of seeking professional care during pregnancy and childbirth and recognising signs of ill health in the newborn	Review: Ames et al. (2019) [29] Original study: Entsieh et al. (2015) [84]
13	Natural Cycles	S	SE	en	Women	f, g	2	Low	E	NaturalCycles has CE certification and US Food and Drug Administration (FDA) approval as a contraceptive Freis et al. (2018) noted some severe study limitations, in their review the app could achieve a score of 2/30 in aplausibility rating [32] Fowler et al. (2020) noted that the app at least required college-level education (Readability and Accessibility of Terms of Service and Privacy Policies) [58] Earle et al. (2021) noted the study fundings and competing interests and rated the studies with an Mixed Methods Appraisal Tool (MMAT)-score of 6.5 to 7.7 (highest possible quality rating). They also referred to some discussions on Natural Cycle as a contraceptive [48•, 102, 103] Some of the study authors may have competing interests [79–82]	Reviews: Freis et al. (2018) [32], Earle et al. (2021) [48•], Ford et al. (2022) [49], Fowler et al. (2020) [58] Original studies: Berglund Scherwitzl et al. (2015) [79], Berglund Scherwitzl et al. (2016) [80], Berglund Scherwitzl et al. (2017) [81], Bull et al. (2019) [82]

**Table 1** (continued)

#	App name	S/T	ctry	lang	Intended audience	SRH topics	Features	GRADE	Study aims	Findings	Studies
14	Ovia Fertility	S	USA	n/a	Women	f, g	2	Low	Q	Findings were consistent with established clinical knowledge, suggesting validity for data collection via app [49], Fowler et al. (2020) [58] Original study; Faust et al. (2019) [83] Fowler et al. (2020) noted that the app at least required college-level education (Readability and Accessibility of Terms of Service and Privacy Policies) [58] Some of the study authors may have competing interests [83]	Review: Ford et al. (2022) [49], Fowler et al. (2020) [58] Original study; Faust et al. (2019) [83]
15	Infertility Handling	SA	HU	hu	Women	f, g	1, 2	Very low	D	Provides basic biological and physiological information to women at different stages of the cycle and information gathering for treatment management, tool for personal medical monitoring	Review: Ford et al. (2022) [49] Original study; Vanya et al. (2017) [63]
16	Lady Cycle	S	DE	de, en	Women	g	2	Very low	Q	Score: 20/30	Review: Freis et al. (2018) [32]
17	Lily	S	DE	de, en	Women	g	2	Very low	Q	Score: 19/30	Review: Freis et al. (2018) [32]
18	myNFP	S	DE	de, en	Women	g	2	Very low	Q	Score: 20/30	Review: Freis et al. (2018) [32]
19	NetMoom Cycle Calendar	S	DE	n/a	Women	g	2	Very low	D	Approach for a period tracking app with an adaptive user interface that takes the users goal and context into account	Review: Earle et al. (2021) [48] Original study; Breuschneider (2015) [64]
20	OvuView	S	DE	de, en	Women	g	2	Very low	Q	Score: 11/30	Review: Freis et al. (2018) [32]
21	Gravidanza+	S	IT	it	PPP	e, g	2, 7, 9	Very low	Q	Fulfilled 45.1% of expected requirements; MARS: 3.9/5	Review: Brunelli et al. (2021) [26]
22	iMamma	S	IT	it	PPP	e, g	2, 7, 8, 9	Very low	Q	Fulfilled 52.1% of expected requirements; MARS total score: 3.5/5	Review: Brunelli et al. (2021) [26]
23	La mia gravidanza (Doctissimo)	S	IT	it	PPP	e, g	2, 7, 9	Very low	Q	fulfilled 47.9% of expected requirements; MARS: 4.0/5	Review: Brunelli et al. (2021) [26]

Table 1 (continued)

#	App name	S/T	ctry	lang	Intended audience	SRH topics	Features	GRADE	Study aims	Findings	Studies
24	Mamma in salute	S	IT	it	PPP	e, g	2, 7, 9	Very low	Q	fulfilled 46.5% of expected requirements; MARS: 4.5/5	Review: Brunelli et al. (2021) [26]
25	Mustela per me	S	IT	it	PPP	e, g	2, 7, 9	Very low	Q	fulfilled 46.5% of expected requirements; MARS: 3.3/5	Review: Brunelli et al. (2021) [26]
<i>SRH apps for children, adolescents and young adults</i>											
26	myPEEPS	S	USA	en	Young MSM	c, f, i	1, 3	Moderate	U, F, A, E	Acceptability, usability, feasibility and efficacy that demonstrated short-term efficacy for reducing sexual risk among same-sex attracted young males was shown Some of the study authors may have competing interests [41]	Review: Queiroz et al. (2021) [5] Original studies: Hidalgo et al. (2015) [6], Kuhns et al. (2020) [7] Additional studies: Cho et al. (2018) [8], Ignacio et al. (2019) [37], Gannon et al. (2020) [38], Cordoba et al. (2021) [39], Anderson et al. (2022) [40], Schnall et al. (2022) [41]
27	PlayForward: Elm City Stories	T	USA	en	Minority Adolescents (11 to 14 y)	c, i	1, 3	Moderate	D, E	Improved sexual health attitudes and knowledge in minority adolescents for at least 12 months Some of the study authors may have competing interests [34, 42]	Review: Stark et al. (2022) [56] Original study: Fiellin et al. (2016) [34] Additional studies: Montanaro et al. (2015) [42], Hietje et al. (2016) [43], Fiellin et al. (2017) [44]
5	Pulse	S	USA	en	Black and Latina young women (18 to 20 y)	a, b, c, f	4, 5, 6, 7, 9, 12	Moderate	D, E	Increase in knowledge regarding contraception, HIV and/or STIs; decrease in reports of having sex without contraception	Review: Chandler et al. (2022) [52] Original study: Manlove et al. (2020) [89]
28	Tumaini	S	USA	en	Young Africans	c	1, 3, 8	Moderate	F, E	Increase in sexual health-related knowledge and self-efficacy, behavioural intention for risk-avoidance strategies and sexual risk communication, and overall survey scores	Review: Stark et al. (2022) [56] Original study: Winskell et al. (2019) [35] Additional study: Winskell et al. (2018) [45]
29	eSTI <sup>2</sup>	S	UK	en	Adolescents (16 to 24 y)	c	2, 8	Low	D, U, A	Design recommendations for SRH-apps for adolescents	Review: Jeminiwa et al. (2019) [50]• Original study: Gkatzidou et al. (2015) [85]



Table 1 (continued)

#	App name	S/T	ctry	lang	Intended audience	SRH topics	Features	GRADE	Study aims	Findings	Studies
9	Health-E-You	T	USA	en	Female Adolescents	f	1, 4, 5, 6	Low	D, U, F, A, E	Increased sexual health knowledge on contraceptive options; influenced adolescents' intentions to use an effective or more effective method of contraception	Reviews: Earle et al. (2021) [48], Ford et al. (2022) [49] Original study: Meshriakova and Tebb (2017) [86]
30	Skyddslaget	S	SE	n/a	Adolescents	c	1, 3, 4, 9	Low	E	No effect on increasing condom use among sexually active youth	Review: Berendes et al. (2021) [27] Original study: Nielsen et al. (2021) [67]
31	Bill Sanders	S/T	DE	de, en, fr, nl, es	Children (3 to 8 y)	i	5	Very low	Q	MARS-G total score = 4.45/5; Sections scores: Engagement = 4.20/5, Functionality = 4.75/5, Aesthetics = 4.83/5, Information = 4.00/5, App still available	Review: Muehlmann et al. (2021) [23]
32	Get Smart	S	USA	en	Adolescents	a	N/A	Very low	Q	Overall Score 32/38; Comprehensiveness Components 9/9; Behaviour Change Techniques 4/6, Health Literacy Strategies 20/23	Review: Kalke et al. (2018) [59]
33	It Matters	S	USA	en	Adolescents	a	N/A	Very low	Q	Overall Score 32/38; Comprehensiveness Components 5/9, Behaviour Change Techniques 8/6, Health Literacy Strategies 18/23	Review: Kalke et al. (2018) [59]
34	My Sex Doctor	S	USA	en	Adolescents	a	N/A	Very low	Q	Overall Score 29/38; Comprehensiveness Components 8/9, Behaviour Change Techniques 5/6, Health Literacy Strategies 16/23	Review: Kalke et al. (2018) [59]
35	Safe	S	USA	en	Adolescents	a	N/A	Very low	Q	Overall Score 32/38; Comprehensiveness Components 9/9, Behaviour Change Techniques 5/6, Health Literacy Strategies 18/23	Review: Kalke et al. (2018) [59]

Table 1 (continued)

#	App name	S/T	ctry	lang	Intended audience	SRH topics	Features	GRADE	Study aims	Findings	Studies
36	SayWhatApp	S	USA	en	Adolescents	a	N/A	Very low	Q	Overall Score 20/38; Comprehensiveness Components 6/9, Behaviour Change Techniques 3/6, Health Literacy Strategies 11/23	Review: Kalke et al. (2018) [59]
37	Sex Positive	S	USA	en	Young Adults	a	N/A	Very low	Q	Overall Score 28/38; Comprehensiveness Components 7/9, Behaviour Change Techniques 5/6, Health Literacy Strategies 16/23	Review: Kalke et al. (2018) [59]
38	Sexual Health Guide	S	USA	en	Adolescents	a	N/A	Very low	Q	Overall Score 19/38; Comprehensiveness Components 5/9, Behaviour Change Techniques 3/6, Health Literacy Strategies 11/23	Review: Kalke et al. (2018) [59]
39	The Real Deal	S	USA	en	Adolescents	a	N/A	Very low	Q	Overall Score 28/38; Comprehensiveness Components 9/9, Behaviour Change Techniques 5/6, Health Literacy Strategies 14/23	Review: Kalke et al. (2018) [59]
<i>SRH apps for healthcare workers and/or patients</i>											
4	Plan A Birth Control	T	USA	en	Women	f	1	Moderate	E	Did not adversely affect highly effective birth control uptake. App can save time for physicians and health educators if used as an adjunct to contraception counselling in waiting room settings	Review: Ford et al. (2022) [49] Original study: Sridhar et al. (2015) [61]
40	Babyscripts	S	USA, BE	en	Healthcare workers and PPP	e	1, 2, 9, 10, 11	Low	F	A system using a mobile phone app coupled to remote monitoring devices is feasible for prenatal care Some of the study authors may have competing interests [2]	Review: Haddad et al. (2019) [1 •] Original studies: Marko et al. (2016) [2]; Lanssens et al. (2017) [3]

**Table 1** (continued)

#	App name	S/T	ctry	lang	Intended audience	SRH topics	Features	GRADE	Study aims	Findings	Studies
41	mHealth Guatemala	S	GT	n/a	Healthcare workers	e	2, 9, 10	Low	D, U, F, A	The initial user testing provided a positive indication that introducing monitoring technology into the practice of traditional birth attendants is feasible	Review: Haddad et al. (2019) [1 •] Original study: Stroux et al. (2016) [68]
42	mPAMANECH	SA	KE	en	Healthcare workers	e	2, 10, 13	Low	F, A	App for health volunteers supports collection of health information. Qualitative study that addressed feasibility and usability of the mPAMANECH app	Review: Haddad et al. (2019) [1 •] Original study: Bakibinga et al. (2017) [36] Additional study: Bakibinga et al. (2020) [46]
43	PANDA (Pregnancy and Newborn Diagnostic Assessment)	SA	CH, MG	n/a	Healthcare Workers	e	1, 2, 10, 11, 13,	Low	U, F, A	App assists in providing comprehensive antenatal care. Healthcare providers were able to collect all variables. No major technical problems were encountered. Acceptability of the system was high. Some of the study authors may have competing interests [69]	Review: Haddad et al. (2019) [1 •] Original study: Benski et al. (2017) [69]
44	Positive Links	S	USA	n/a	Adults with HIV positive status	c, i	1, 2, 8, 9, 10	Low	E	People who posted stigma-related content were more likely to show reduced stigma levels after 12 months	Review: Abdulai et al. (2022) [51 ••] Original study: Flickinger et al. (2018) [70]

Table 1 (continued)

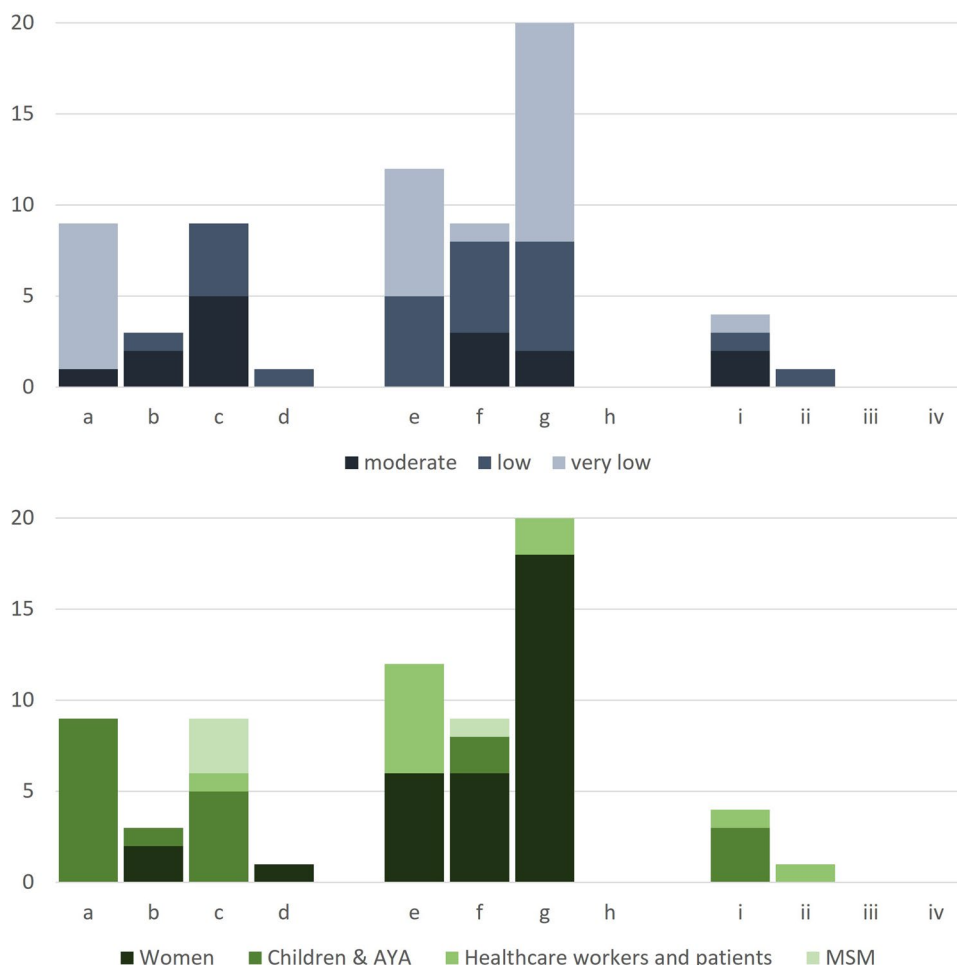
#	App name	S/T	ctry	lang	Intended audience	SRH topics	Features	GRADE	Study aims	Findings	Studies
45	Safer Conception Intervention for Partners app	T	KE	n/a	Healthcare Workers (Providers during consultations with couples who were HIV serodiscordant)	g, ii	2, 10	Low	F, A	Feasible to use and acceptable to support the delivery of safer conception intervention services among HIV serodiscordant couples Kirkwood et al. (2018): positive transformative gender relations: increased women's knowledge, which enabled more informed decisions regarding health, strengthened health, strengthened communication with partners and increased health-related joint decision-making between partners; but also negative transformative gender relations: a report of verbal and physical abuse was related to a misconception about the source of SMS text messages [55••]	Review: Kirkwood et al. (2022) [55••] Original study: Vellozo et al. (2019) [71]
46	fHealth Patient App/ fHealth Doctor App	SA	BG	n/a	Healthcare workers and patients (women)	g	2, 9, 10, 11, 13	Very low	D	Can assist communication, medical procedures, decision-making of patients and specialists in the field of fertility and female health in general	Review: Ford et al. (2022) [49] Original study: Shopov et al. (2019) [65]
47	OpenSRP (Open Smart Register Platform)	S	BD	n/a	Healthcare workers (local health workers)	e	1, 2, 9, 10, 13	Very low	Q	Is designed for recording and including health data of clients in locations where conditions are suboptimal. Developed by a joint collaboration between institutions, including the World Health Organization (WHO), UNICEF and Harvard School of Public Health. Concerning requirements considered relevant by Haddad et al. (2019), OpenSRP was the most complete solution [1•]	Review: Haddad et al. (2019) [1•]

**Table 1** (continued)

#	App name	S/T	ctry	lang	Intended audience	SRH topics	Features	GRADE	Study aims	Findings	Studies
48	POTM	S	CA, NG, MZ, PK, IN	Multiple languages	Healthcare workers and PPP	e	2, 10, 13	Very low	D, U	Diagnosis and management of pregnant women with pre-eclampsia via app are described	Review: Haddad et al. (2019) [1•] Original study: Dunsmuir et al. (2014) [66]
<i>SRH apps for men</i>											
26	myPEEPS	S	USA	en	Young MSM	c, f, i	1, 3	Moderate	U, F, A, E	Acceptability, usability, feasibility and efficacy that demonstrated short-term efficacy for reducing sexual risk among same-sex attracted young males was shown Some of the study authors may have competing interests [41]	Review: Queiroz et al. (2021) [5] Original studies: Hidalgo et al. (2015) [6], Kuhns et al. (2020) [7] Additional studies: Cho et al. (2018) [8], Ignacio et al. (2019) [37], Gan-non et al. (2020) [38], Cordoba et al. (2021) [39], Anderson et al. (2022) [40], Schmall et al. (2022) [41]
49	WeChat	S	CN	n/a	MSM	c	1, 6, 9	Moderate	F, A, E	Increased HIV (self-) testing behaviour and trust in results of HIV self-test results; experimental and control group reported increasing condom use	Review: Berendes et al. (2021) [27] Original study: Zhu et al. (2019) [90]
50	HealthMindr	S	USA	en	MSM	c	1, 2, 9, 12	Low	U, A	App was acceptable to MSM and was rated as having above-average usability	Review: Queiroz et al. (2021) [5] Original study: Sullivan et al. (2017) [62]

**Annotations:** Codes for countries (ctry): ISO-3166-Alpha-2/Languages (lang): ISO 639-1; S, smartphone; SA, smartphone (android); T, tablet; IPV, intimate partner violence; PPP, pregnant and postpartum persons. Sexual health areas: (a) comprehensive education and information, (b) gender-based violence prevention, support and care, (c) prevention and control of HIV and other sexually transmissible infections, (d) sexual function and psychosexual counselling; reproductive health areas: (e) antenatal, intrapartum and postnatal care, (f) contraception counselling and provision, (g) fertility care, (h) safe abortion care; social-structural factors: (i) cultural and social norms around sexuality, (ii) gender and socioeconomic inequalities, (iii) human rights, (iv) laws, policies, regulations and strategies; app-features: (1) providing information, (2) enables data collection (tracking/notes/records), (3) gamification (games/quizzes/scenarios/role plays), (4) inter-active components, (5) audio stories, (6) video content, (7) faq, (8) community (social support, sharing posts), (9) reminders and push notifications, (10) communication with experts/providers, (11) sharing data (between client and provider/healthcare worker), (12) linkage to offline care services, (13) decision-making support. Possible quality of evidence GRADE levels is as follows: very low, low, moderate, high. Study aims: D, development; U, usability; F, feasibility; A, acceptability; E, efficacy; MARS(-G), Mobile Application Rating Scale (German version): likert-scaled with 0 lowest to 5 highest possible score

**Fig. 1** Number of apps that covered the WHO SRH topics: (a) comprehensive education and information, (b) gender-based violence prevention, support and care, (c) prevention and control of HIV and other STIs, (d) sexual function and psychosexual counselling, (e) antenatal, intrapartum and postnatal care, (f) contraception counselling and provision, (g) fertility care, (h) safe abortion care; Social-structural factors: (i) cultural and social norms around sexuality, (ii) gender and socioeconomic inequalities, (iii) human rights, (iv) laws, policies, regulations and strategies [20]. AYA, adolescents and young adults. *Upper* chart distinguishes between GRADE Levels of Evidence (possible: very low, low, moderate, high). The *lower* chart between intended audience groups. Apps aimed at young MSM are presented in the MSM group, those aimed at young women are presented in the Children & Adolescents and young adults group



is structured accordingly to these four groups. For each audience group, one app is described in more detail as an example.

For women, 25 apps, including 7 with a focus on pregnant and postpartum persons, were identified. *Plan A Birth Control* is a tablet app available in English. It informs women about possible contraception options and their effectiveness while they are waiting for a face-to-face consultation with a physician. Tested in a real-life setting, the app was shown to save time without compromising the overall quality of the counselling [61].

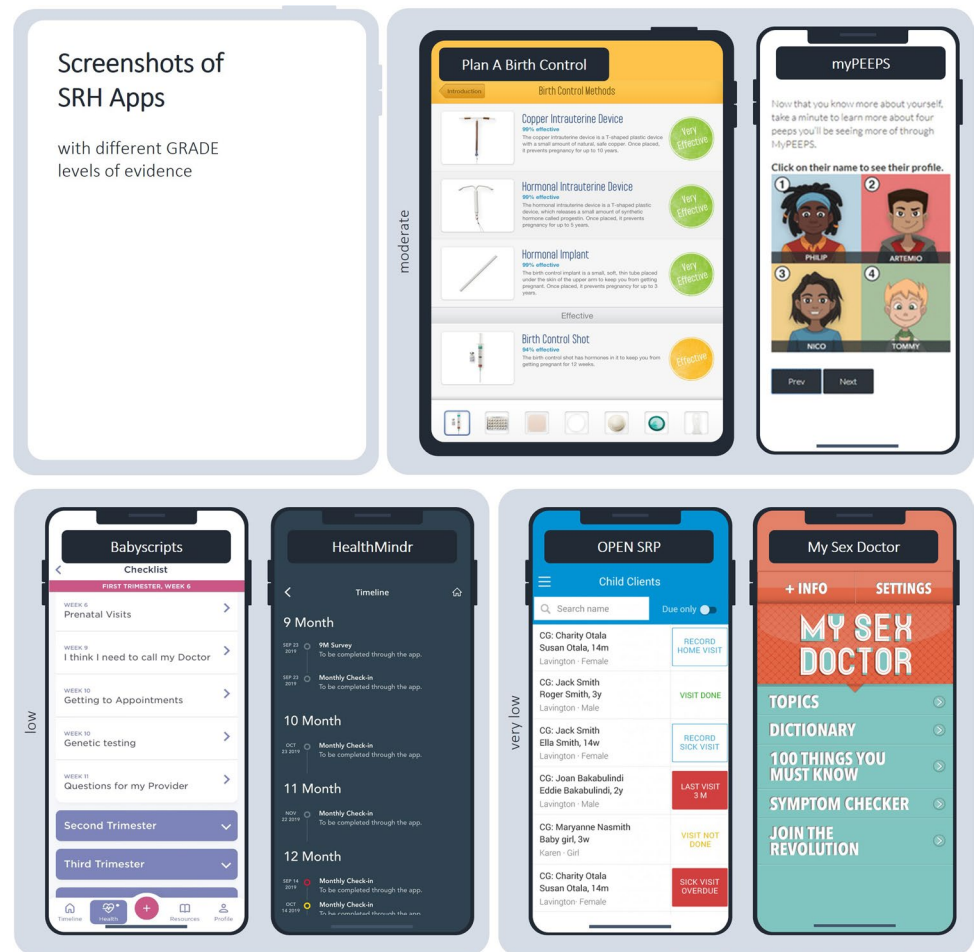
For children, adolescents and young adults 16 apps were identified. One of them is the app *My Sex Doctor* [59]. The smartphone app is available in English as well. It is an app that was designed with the aim to provide comprehensive sex education for adolescents covering a variety of SRH topics. Contents are presented in a Q&A format and include short text explanations on various subjects. There is also a dictionary-function that helps clarifying meanings of SRH-related terms. Adolescents can further check for symptoms that may indicate STIs. There are two versions of the app available (one being suitable for adolescents aged 12 to 16

and one for those that are older). Kalke et al. (2018) rated the app with an overall score of 29 out of possible 38 [59].

Ten apps were designed for healthcare workers and/or patients. Those are mostly apps that assist in data collection and decision-making processes of healthcare workers and support the interaction between professionals and their patients via in-app education or data sharing. *OpenSRP* supports local health workers through a smartphone app. It offers them educational information, enables data collection, supports decision-making and prompts appointment reminders as well as warn signals. Communication and coordination between different healthcare workers are also possible. Regarding the requirements considered relevant by Haddad et al. (2019), *OpenSRP* fulfilled the most of the requirements in contrast to the other examined solutions [1•].

The 3 apps aimed at men specialised on MSM. One App is the smartphone app *HealthMindr* available in English. The app contained tools which help with self-assessment [5]. It recommends prevention strategies to the users and assists them in ordering condoms and HIV self-tests [5]. The app also reminds people about prevention services, condom use, HIV testing and screening [5]. Sullivan et al. (2017)

**Fig. 2** Screenshots of SRH apps with different GRADE levels. Possible quality of evidence ratings is high, moderate, low or very low. No SRH app achieved a high rating



found HealthMindr acceptable for MSM and considered its usability to be above average [62].

**Evaluation of SRH Apps** Figure 2 shows a selection of SRH apps for different GRADE levels. Following the GRADE approach, almost half of the apps ( $n=23$ ) were rated as *very low* regarding quality of evidence. This mostly ( $n=19$ ) included apps that were rated in app reviews according to their quality, without any information on further research [1, 23, 26, 32, 59]. Some articles described the development of apps without testing them with the target group or with an insufficient number of participants [63–65]. A usability approach was mentioned in one study [66].

Studies for 18 apps were rated *low*. Those studies were no RCTs or had some severe limitations [2, 3, 36, 46, 61, 62, 67–86]. These included studies on feasibility ( $n=9$ ), acceptability ( $n=8$ ), efficacy ( $n=6$ ), usability ( $n=5$ ), development ( $n=4$ ) and quality (validity) study ( $n=1$ ).

Studies on 9 apps fell in the category *moderate*: *AKUD* [87], *ClearBlue* [60], *myPEEPS* [6–8, 37–41], *myPlan* [88], *Plan A Birth Control* [61], *PlayForward: Elm City Stories*

[34, 42–44], *Pulse* [89], *Tumaini* [35, 45] and *WeChat* [90]. These included studies on efficacy ( $n=9$ ), feasibility ( $n=4$ ), acceptability ( $n=3$ ), development ( $n=2$ ) and usability ( $n=1$ ).

Following the GRADE approach, no app obtained a *high* quality of evidence rating. This would require several high-quality studies indicating no further research is needed to be sure about the estimated effect.

### Case Study: Availability and Development of SRH Apps in Germany

In order to keep track of the current apps, it is essential to monitor the apps availability at regular intervals. Building on a previous work from 2019 [23] in 2022, an update for the German app stores was conducted. Developments in the field of sexual education apps for children and adolescents are presented in order to illustrate the dynamics of the app market. Three years after the original study (December 2022), the app stores (Apple App Store, Google Play) were searched again with the same inclusion and exclusion

**Table 2** MARS-G rating German sexual education apps

App name	A	B	C	D	Total	PT	E	F	Rated
Das bin ich!***	4.5	5.0	5.0	4.7	<b>4.8</b>	4.0	4.1	3.8	2022
KNOWBODY**	4.5	4.9	5.0	4.3	<b>4.7</b>	4.8	4.1	4.7	2022
Sexuell Gesund***	4.4	4.6	2.8	4.5	<b>4.1</b>	4.5	3.8	4.4	2022
Klar und Einfach**	3.1	3.8	3.7	3.6	<b>3.5</b>	3.3	2.4	3.8	2022
Bill Sanders (iOS only)	4.2	4.8	4.8	4.0	<b>4.5</b>	3.2	3.4	3.1	2019
Wie funktioniert mein Körper?	4.1	3.3	3.8	2.8	<b>3.5</b>	2.8	2.5	2.1	2019
Only Human**	2.5	2.8	2.0	4.0	<b>2.8</b>	3.8	2.5	4.0	2019
Sexting (iOS only)**	2.4	2.8	1.8	3.6	<b>2.6</b>	3.3	2.0	3.8	2019
StartChla*	3.1	4.6	4.7	4.0	<b>4.1</b>	3.6	2.6	3.8	2019
Amorelie Love Trainer*	3.2	4.1	4.3	3.2	<b>3.7</b>	1.9	2.1	2.1	2019
M (SD)	3.3 (0.7)	3.7 (0.8)	3.6 (1.2)	3.6 (0.5)	<b>3.5 (0.7)</b>	3.1 (0.6)	2.5 (0.5)	3.2 (0.8)	2019
Apps available in 2019									
M (SD)	<b>3.7 (0.8)</b>	<b>4.0 (0.9)</b>	<b>3.6 (1.2)</b>	<b>3.9 (0.6)</b>	<b>3.8 (0.8)</b>	<b>3.7 (0.6)</b>	<b>3.1 (0.8)</b>	<b>3.7 (0.8)</b>	<b>19/22</b>
Apps currently available									

*Annotations:* When not noted otherwise, all apps are available on both platforms (Apple App Store and Google Play). *MARS-G*, Mobile Anwendungen Rating Skala (German Version of the MARS). Sections of the MARS-G: *A*, Engagement; *B*, Functionality; *C*, Aesthetics; *D*, Information; *E*, Subjective Quality; *PT*, Psychotherapy; *F*, Perceived Impact. The total value was calculated from sections A–D. The total value of the MARS-G rating for each individual app as well as the mean section scores for apps currently available are highlighted in bold. With a few exceptions, the items of the MARS-G are Likert-scaled (1 — poor, 2 — bad, 3 — acceptable, 4 — good, 5 — excellent). Ratings from 2019 were published before in Muehlmann et al. [23]

\* Apps were not available anymore in 2022

\*\* Apps identified through search terms: Sexual education (Sexuelle Bildung), Educating (Aufklärung), Sex education (Sexualerziehung)

criteria. The most relevant search terms were used. Those are as follows: Sexual education (Sexuelle Bildung), Educating (Aufklärung), Sex education (Sexualerziehung). To enable comparability with the original study, the same raters also rated the new apps using the *Mobile Anwendungen Rating Skala* (MARS-G) [91] — the German Version of the *Mobile Application Rating Scale* (MARS) [92]. To allow a comparison, Table 2 presents the new as well as the original ratings.

Four sexual education apps were additionally identified. One of the apps is designed for children (*Das bin ich!*) and three of the apps are designed for adolescents (*KNOWBODY*, *Sexuell Gesund*, *Klar und Einfach*). Two of the apps from 2019 were no longer available in the app stores. Four of the 8 sexual education apps achieved an overall (*total*) rating of *good* (4) or better. On average, at least *acceptable* (3) scores were achieved in the individual sections of the MARS-G. From 2019 to 2022, the overall quality of apps increased ( $M_{2019} = 3.5$  (*StartChla* and *AMORELIE* included),  $M_{2022 \text{ available}} = 3.8$ ).

## Discussion

This article presents the current state of research on SRH apps. In the following section, the contents, typical features, intended audiences and the quality of evidence of SRH apps

are discussed. Challenges in investigating SRH apps are addressed as well.

## Contents of SRH Apps

Among the apps identified in the study, there were many focusing on comprehensive education and fertility care, which includes menstrual tracking apps. However, most apps with these contents achieved *very low* GRADE ratings. Nine apps on prevention and control of HIV and other STIs (mostly for MSM, adolescents and young adults) with at least a *low* quality of evidence were identified. Another eight apps on contraception counselling and provision and eight on fertility care (usually for women and healthcare workers) also achieved a *low* or, in some cases, a *moderate* GRADE level. There were five apps (mostly aimed at healthcare workers) that supported antenatal, intrapartum and postnatal care with at least a *low* GRADE level. Three apps included contents on gender-based violence prevention, support and care and only a single app aimed at promoting sexual function and psychosexual counselling. All of these were rated with a *low* GRADE level or higher. Even though some apps might include abortion as a topic no SRH-app could be identified that focused on abortion care. As an SRH issue with a high mortality, health apps dealing with said topic could be a potential aid when it comes to the decision-making process or to reducing the stigma still attached to abortion [93, 94].



Social-structural factors were rarely the primary aim of the apps although they are highly relevant for the way we deal with SRH [20]. Even if they are taken into account for example through the selection of the intended audiences (e.g. MSM), there is still a need for research that explicitly investigates the possibility of shaping context factors using app-based technology in order to promote SRH [20]. Three *low* or *moderate* quality apps addressed cultural and social norms around sexuality, and one was noted to be transformative on gender relations [55••]. Other social-structural factors may have been addressed indirectly. For instance, gender inequalities can be addressed in gender-based violence prevention apps. However, they were neither the main contents of the apps nor mentioned explicitly in the studies.

### Features of SRH Apps

More than half of the apps (62%) enabled data collection, mostly the possibility to self-track menstruation or to manage symptoms. Providing educational information was also a fundamental part of 38% of the apps. Reminders or push notifications were used in 32% of the apps. Audio or video content, as well as gamification or interactive components, was mentioned less frequently overall. Other aspects like the possibility of communicating with experts or having typical questions answered in-app were only available in some of the apps. The same applies to the support of decision-making processes, peer discussions in forums and data sharing and the linkage to offline care services. However, the small percentages of those features can be explained by the high number of menstrual tracking apps. Depending on the target group, various features were used differently.

### Intended Audiences of SRH Apps

Four audience groups were addressed by the apps. The vast majority of which, particularly menstrual tracking apps, were aiming at women including pregnant and postpartum persons. There were also a lot of apps for children, adolescents and young adults containing various educational insights. Those apps mostly provided information using audio or video content, gamification or other interactive components. Some apps were designed to support interactions between healthcare workers and patients and a few apps aimed at MSM for HIV prevention and management. Those SRH apps typically enabled data collection for users, which in turn can support keeping track of current health statuses as well as in-app communication with experts. A few apps also allowed sharing data between clients and professionals. There were no apps for men in general, which does not come as a surprise given that only one article targeted them [28]. This can be explained by numerous fertility care studies, which often tend to focus on women. However, men might benefit from digital health interventions when it comes to their

own SRH and may be involved in preconception care as well [95, 96] and therefore a more balanced proportion in research would be desirable. The same applies for *LGBTQIA+* groups, who could benefit from well-designed and relevant health apps [4], as besides apps for MSM, no further apps were mentioned.

### Evaluation of SRH Apps

Various studies note that the app market is developing rapidly and the availability of health apps is constantly changing [7, 13, 23, 24]. Keeping track of currently available and relevant apps is almost impossible, especially when it comes to a field as broad as SRH. Authors of app reviews are trying to overcome this issue by systemising the current market [1•, 5, 23–26, 28, 32, 33, 58, 59]. However, they often lack the tools to recommend high-quality and relevant apps for practice [5, 24, 25, 58]. In addition, studies in which quality assessment scales are used [23, 26, 58] or those with articles that date back to 2014 [1•, 66] covered apps that may no longer be available or only in modified versions. In order to keep an overview of the current apps, it is therefore essential to view the apps at regular intervals and with the shortest possible delay in the publication process. When it comes to German sexual education apps, in the last 3 years, a positive development in the availability and quality has been observed. Two out of 6 apps could no longer be downloaded. Apps in other languages and with other SRH-focuses should also be regularly reviewed and evaluated. For practical purposes, databases that contain currently relevant apps should be made more apparent in order to facilitate better awareness of the wider audience regarding the apps available. Otherwise, it can be difficult for intended users to identify adequate apps [97].

Besides the overwhelming number, the efficacy of SRH apps has not yet been sufficiently studied in a scientific manner. Figure 2 shows a selection of apps sorted by GRADE level. Individual apps were deemed to be rated with at least a *moderate* GRADE level in the present study. The apps aimed at women are *AKUD*, *ClearBlue*, *myPlan*, *Plan A Birth Control* and *Pulse*. Those targeting adolescents and young adults are *myPEEPS*, *PlayForward*, *Pulse* and *Tumaini* and those for MSM are *myPeeps* and *WeChat*. Apps for women showed the potential to improve SRH by decreasing menstrual pain (*AKUD*), increasing of the conceiving likelihood (*ClearBlue*), increases in knowledge and skills due to intimate partner violence (*myPlan*) as well as knowledge gain on contraception options (*Plan A Birth Control*). Adolescents and young adults benefitted from apps by improving their health knowledge (*Playforward*, *Pulse*, *Tumaini*), attitudes (*PlayForward*, *Tumaini*) and self-efficacy (*Tumaini*) as well as by decreasing their reported sexual risk behaviour (*Pulse*). Apps for MSM reduced sexual risk behaviour (*mePEEPS*, *WeChat*) and enhanced self-testing behaviour (*WeChat*).

Apps from app reviews usually showed *very low* quality of evidence, as in the framework of the GRADE approach, those studies are not considered sufficient enough. It is possible that among the apps for which no pilot or RCT study was found, there are some that may have a positive impact on SRH. Some of the apps showed content expert ratings indicating that they are of good quality and therefore have the potential to improve people's SRH [1•, 23, 32, 59]. Thus, apps such as *iMamma* could support people during their pregnancy, *My Sex Doctor* could provide helpful information for adolescents and *OpenSRP* could support healthcare workers in their decision-making processes when no well-tested alternative is available.

In order to have a positive impact on SRH, it would be useful if apps would not only be of high-quality design and have relevant content, but they should also be tailored to the intended target group [4]. Especially younger audiences can be skeptical about app use [98]. In addition, it is useful to embed the apps in educational or healthcare settings so that users are not left on their own when using them. A good start is the possibility to communicate with experts via the app, as provided in some apps. However, a better approach would be to integrate the app in a real-life environment such as school lessons. A good example was provided by Sridhar et al. (2015), who examined an educational app (*Plan a Birth Control*) in the intended setting (waiting room) [61]. The authors found that the app can be used to prepare women for meeting with a doctor, saving time and increasing the overall quality of the consultation [61].

## Limitations

Comparability between studies is limited. Often study-specific scales and categories are developed to assess quality, function or content of the apps [1•, 24, 25, 32, 33, 59]. In single studies, scientifically sound scales for quality ratings were used, which, however, are not tailored to SRH or the intended audience group [23, 26, 58]. One study explicitly focused on developing a framework for assessing general health apps for adolescents that could be helpful in studies for this specific target group [50••]. Harmonisation would be helpful in order to be able to compare studies and adequately reflect the current state of scientific knowledge. Thus, the selection of apps in this study can only be comprehensive to a limited extent. It is possible that among the apps, for which no pilot or RCT study was found, there are some that can impact SRH positively. This is especially true for articles that did not conduct any quality rating [5, 24, 25]. This may result in relevant apps not being included in the study. Additionally, to promote SRH, different outcomes have been measured across different studies, making it difficult to draw firm conclusions about the effectiveness of apps overall. Harmonisation here would be helpful as well. In order to address this issue in a concise manner, study aims and findings for each app are noted in Table 1.

For five apps, new articles were searched manually via the app name as well as the names of the authors of the original studies. Additional papers could be identified in every case indicating that there are more current studies for some of the other apps as well. These are not included in the present article, as it would have exceeded the scope of this study. Due to geographical location and language capabilities, it was not possible to verify for all apps whether they were still available or whether they exceeded the contents and functions reported in the studies. It is possible that some of the analysed apps are no longer available due to the fast changing market of health apps [10, 21, 32, 33].

For app assessment, the GRADE approach proposed by *the GRADE Working Group* was followed to distinguish whether the Quality of Evidence was (a) high, (b) moderate, (c) low or (d) very low [47]. Ratings were only conducted by a single scientist (MM) and not double checked to enhance the validity. Expert opinion is not a category of quality of evidence due to GRADE [47]. Nevertheless, apps that have been rated with relevant scales by experts were included, even if the intended audience itself was not involved (see Appendix 2 for more details on the selection of apps).

## Conclusions

In this study, SRH apps that are known among the scientific community were examined. Many apps cover a variety of SRH topics, but they often lack high-quality assessment. In order to improve SRH, it would be helpful if apps were of high-quality design, contained relevant evidence-based content, would be tailored to the intended audience and tested in real-life settings [4, 16, 92, 99]. But this does not necessarily mean that less researched apps cannot positively influence health. Even some apps with a very low level of evidence showed relevant contents and promising features to support people in managing their SRH.

Finally, a common issue in the field of SRH interventions emerged again in the present study [100, 101]. Outcomes that are used for effectiveness measurements are not necessarily all factors that lead to *good* SRH according to our present understanding. Negative factors such as limiting risk behaviour and preventing diseases as well as knowledge gain are still the primary focus. However, there were also studies which set a good example by noting other outcomes. Among these are enhanced feelings of confidence and resilience [88], well-informed SRH decisions [88] and the ability to initiate SRH discussions [72]. In addition to traditional outcomes, there should be a greater emphasis on examining positive-psychological and competence-oriented variables.

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**Data Availability** The authors confirm that the data supporting the findings of this study are available within the article and its supplementary materials.

## Compliance with Ethical Standards

**Human and Animal Rights Statement** This article does not contain any studies with human or animal subjects performed by any of the authors.

**Informed Consent** This article does not include individual participants. Therefore, no informed consent is needed.

**Conflict of Interest** The authors declare no competing interests.

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- Of importance
- Of major importance

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