Preferences regarding information strategies for digital mental health interventions among medical students in Germany: A discrete-choice experiment

Markus Vomhof, Jessica Tabea Bau, Pia Hüter, Stefan Stehl, Burkhard Haastert, Adrian Loerbroks, Andrea Icks, Stella Teresa Calo, Luca Schuster, Claudia R. Pischke, Nadja Kairies-Schwarz, Peter Angerer, Jennifer Apolinário-Hagen

Submitted to: JMIR Formative Research
on: December 29, 2023

Table of Contents

Preferences regarding information strategies for digital mental health interventions among medical students in Germany: A discrete-choice experiment

Markus Vomhof[1, 2*] Dr; Jessica Tabea Bau[3, 4*] MSc; Pia Hüter[3] MSc; Stefan Stehl[3]; Burkhard Haastert[1, 5] Dr; Adrian Loerbroks[3] Prof Dr; Andrea Icks[1, 2] Prof Dr, Dr; Stella Teresa Calo[1, 2] MSc; Luca Schuster[3]; Claudia R. Pischke[4] Prof Dr; Nadja Kairies-Schwarz[1] Prof Dr; Peter Angerer[3] Prof Dr; Jennifer Apolinário-Hagen[3] Dr

[1]Institute for Health Services Research and Health Economics Centre for Health and Society, Medical Faculty and University Hospital Düsseldorf Heinrich Heine University Düsseldorf Düsseldorf DE
[2]Institute for Health Services Research and Health Economics German Diabetes Center, Leibniz Center for Diabetes Research Heinrich Heine University Düsseldorf Düsseldorf DE
[3]Institute of Occupational, Social and Environmental Medicine Centre for Health and Society, Medical Faculty and University Hospital Düsseldorf Heinrich Heine University Düsseldorf Düsseldorf DE
[4]Institute of Medical Sociology Centre for Health and Society, Medical Faculty and University Hospital Düsseldorf Heinrich Heine University Düsseldorf Düsseldorf DE
[5]mediStatistica Wuppertal DE
[*]these authors contributed equally

Corresponding Author:
Jessica Tabea Bau MSc
Institute of Medical Sociology
Centre for Health and Society, Medical Faculty and University Hospital Düsseldorf
Heinrich Heine University Düsseldorf
Moorenstraße 5
Düsseldorf
DE

Abstract

Background: The impact of digital mental health interventions (DMHIs) in the prevention and therapy of common mental disorders (CMDs) on healthcare has been debated in view of the currently low utilization rates. Potential reasons may include lacking awareness or familiarity with DMHIs as well as concerns about their quality, trusted sources and the evidence base, which calls for context-sensitive information campaigns. Medical students represent a suitable user case to develop information strategies as they were previously shown to have a comparatively high risk for CMDs themselves. Further, in their role as future physicians, they will prescribe DMHIs. Yet, little is known about medical students´ information preferences regarding DMHIs.

Objective: The aim of the study was to explore information preferences for DMHIs among medical students in Germany for personal use.

Methods: A discrete choice experiment (DCE) was conducted, which was developed using an exploratory sequential mixed-methods research approach. Five attributes (i.e., source, delivery mode, timing, recommendation, and quality criteria) each with 3-4 levels were identified using formative research. Twenty-four choice sets each with two alternatives were divided into three versions of the DCE, each with eight different choice sets, to which participants were randomly assigned. DCE data were analyzed employing logistic regression models to estimate preference weights and relative importance of attributes. To identify subgroups of students varying in information preferences, we additionally performed a latent class analysis (LCA).

Results: Out of N=309 eligible participants data, n=231 were included in the main analysis due to reliable data (70.1% women, age: M=24.1 years, SD=4.0 years). Overall, medical students preferred to receive information about DMHIs from the student council and favored being informed via social media early (i.e., during their pre-clinic phase or their freshman week). Recommendations from other students or health professionals were preferred over recommendations from other users or no recommendation at all. Information about the scientific evidence base were the preferred quality criterion. Overall, timing of the provision of information was the most relevant attribute (32.6%). LCA revealed two distinct subgroups. Class 1 preferred to

receive extensive information about DMHIs in a seminar, while class 2 wanted to be informed digitally (via e-mail or social media) and as early as possible in their studies.

Conclusions: Medical students have specific needs and preferences regarding DMHI information. Timing of information (early in medical education) was considered more important than information source or delivery mode, which should be prioritized by decision makers (e.g., members of faculties of medicine, university, ministry of education). This DCE provides novel insights into what is important when informing medical students about DMHIs and how complex and potentially well-accepted information strategies can be deduced by considering the preferences of the target group. Clinical Trial: The DCE was pre-registered at the Open Science Framework (OSF) in October 2022: https://osf.io/2s9u8.

(JMIR Preprints 29/12/2023:55921)
DOI: https://doi.org/10.2196/preprints.55921

Preprint Settings

1) Would you like to publish your submitted manuscript as preprint?

✓ **Please make my preprint PDF available to anyone at any time (recommended).**
Please make my preprint PDF available only to logged-in users; I understand that my title and abstract will remain visible to all users.
Only make the preprint title and abstract visible.
No, I do not wish to publish my submitted manuscript as a preprint.

2) If accepted for publication in a JMIR journal, would you like the PDF to be visible to the public?

✓ **Yes, please make my accepted manuscript PDF available to anyone at any time (Recommended).**
Yes, but please make my accepted manuscript PDF available only to logged-in users; I understand that the title and abstract will remain v
Yes, but only make the title and abstract visible (see Important note, above). I understand that if I later pay to participate in <a href="http

Original Manuscript

Original Paper

Author information

1. Markus Vomhof[1,2*] (ORCID: 0000-0002-2714-6371)
2. Jessica T. Bau[3,5*] (ORCID: 0009-0005-4368-2173)
3. Pia Hüter[5] (ORCID: 0000-0003-2179-4842)
4. Stefan Stehl[5]
5. Burkhard Haastert[1,4] (ORCID: 0000-0002-5108-158X)
6. Adrian Loerbroks[5] (ORCID: 0000-0003-2795-8684)
7. Andrea Icks[1,2] (ORCID: 0000-0002-4882-969X)
8. Stella Calo[1,2] (ORCID: 0009-0007-1682-1590)
9. Luca Schuster[5] (ORCID: 0009-0008-8330-3133)
10. Claudia R. Pischke[3] (ORCID: 0000-0002-2256-8903)
11. Nadja Kairies-Schwarz[1] (ORCID: 0000-0001-6164-959X)
12. Peter Angerer[5] (ORCID: 0000-0002-9602-7405)
13. Jennifer Apoliário-Hagen[5] (ORCID: 0000-0001-5755-9225)

[1] Institute for Health Services Research and Health Economics, Centre for Health and Society, Medical Faculty and University Hospital Düsseldorf, Heinrich Heine University Düsseldorf, Germany
[2] Institute for Health Services Research and Health Economics, German Diabetes Center, Leibniz Center for Diabetes Research at Heinrich Heine University Düsseldorf, Düsseldorf, Germany
[3] Institute of Medical Sociology, Centre for Health and Society, Medical Faculty and University Hospital Düsseldorf, Heinrich Heine University Düsseldorf, Germany
[4] mediStatistica, Wuppertal, Germany
[5] Institute of Occupational, Social and Environmental Medicine, Centre for Health and Society, Medical Faculty and University Hospital Düsseldorf, Heinrich Heine University Düsseldorf, Germany

Corresponding Author: Jessica T. Bau
Institute of Medical Sociology, Centre for Health and Society, Medical Faculty and University Hospital Düsseldorf, Heinrich Heine University Düsseldorf, Moorenstr. 5, 40225 Düsseldorf, Germany
Email: Jessica.bau@hhu.de
Phone: +49 211 8106557

Preferences regarding information strategies for digital mental health interventions among medical students in Germany: A discrete-choice experiment

Abstract

Background: Digital mental health interventions (DMHIs) are capable to close gaps in the prevention and therapy of common mental disorders. Despite proven effectiveness and approval for prescription, utilization rates remain low. Reasons include a lack of familiarity and knowledge as well as lasting concerns. Medical students were shown to have a comparatively high risk for common mental disorders and are thus an important target group for raising awareness about DMHIs. At best, knowledge is already imparted during medical school, using context-sensitive information strategies. Yet, little is known about medical students´ information preferences regarding DMHIs.

Objective: The aim of the study was to explore information preferences for DMHIs among medical

students in Germany for personal use.
Methods: A discrete choice experiment was conducted, which was developed using an exploratory sequential mixed-methods research approach. Five attributes (i.e., source, delivery mode, timing, recommendation, and quality criteria) each with three to four levels were identified using formative research. Data were analyzed employing logistic regression models to estimate preference weights and relative importance of attributes. To identify subgroups of students varying in information preferences, we additionally performed a latent class analysis.
Results: Out of N=309 participants, n=231 were included in the main analysis due to reliable data (70.1% women, age: M=24.1 years, SD=4.0 years). Overall, conditional logit model revealed that medical students preferred to receive information about DMHIs from the student council and favored being informed via social media early (i.e., during their pre-clinic phase or their freshman week). Recommendations from other students or health professionals were preferred over recommendations from other users or no recommendation at all. Information about the scientific evidence base were the preferred quality criterion. Overall, timing of information was the most relevant attribute (32.6%). Latent class analysis revealed two distinct subgroups. Class 1 preferred to receive extensive information about DMHIs in a seminar, while class 2 wanted to be informed digitally (via e-mail or social media) and as early as possible in their studies.
Conclusion: Medical students reported specific needs and preferences regarding DMHI information provided in medical school. Overall, timing of information (early in medical education) was considered more important than information source or delivery mode, which should be prioritized by decision makers (e.g., members of faculties of medicine, university, ministry of education). Study findings suggest general and subgroup-specific information strategies, which could be implemented in a stepped approach. Easily accessible digital information may promote students' interest in DMHIs in a first step that might lead to further information-seeking behavior and the attendance of seminars about DMHIs in a second step.
Trial registration: The DCE was pre-registered at the Open Science Framework (OSF) in October 2022: https://osf.io/2s9u8.

Keywords: preferences, digital mental health, medical students, innovation diffusion, technology acceptance, health information

Introduction

Despite the considerable burden attributable to common mental disorders (CMDs), numerous structural obstacles to the utilization of (face-to-face) psychological interventions such as waiting times remain [1]. In addition, individual-level barriers, such as skepticism about the helpfulness and safety, self-stigma or simply a lack of awareness of appropriate services, are well documented [2,3]**.** Given the need for lowering the threshold to access psychological interventions, digital mental health interventions (DMHIs) can play a key role [4]. They can be differentiated by their application field (e.g., prevention vs. therapy), technical modality (e.g., app, virtual reality), guidance (varying in source, timing and intensity; e.g., via videoconference) or application area (e.g., stand-alone vs. blended care), and theory base (e.g., Cognitive Behavioral Therapy) [5,6]. With the Digital Healthcare Act, German health policy created new regulations for the certification and reimbursement of costs for prevention and healthcare contexts. Since October 2020, physicians and psychotherapists are allowed to prescribe specific certified medical applications (German: *Digitale Gesundheitsanwendungen*; DiGA) listed in a repository by the Federal Institute for Drugs and Medical Devices (German: Bundesinstitut für Arzneimittel und Medizinprodukte; BfARM), including digital therapeutics for different CMDs, on the expense of statutory health insurance companies [7,8]**.** Nevertheless, the general use of DMHIs across European countries in the past years [4] as well as the uptake of DMHIs in terms of DiGA in Germany in recent times is marginal and appears to be hampered by individual-level barriers, such as doubts and lacking knowledge among healthcare professionals (HCPs) and patients [9,10]. In addition, the diffusion process is also affected by health policy barriers, such as adverse regulations and increasing barriers to market entry for potential DiGA providers [11]. The distinction between permanent and temporary listing of DiGA has also been criticized especially by statutory health insurance companies. While most DiGA in the field of DMHIs are permanently listed based on their scientific evidence base, the so-called fast-track certification of DiGA has raised concerns about the scientific foundation of temporarily listed DiGA. This means that manufacturers that meet the criteria by the BfArM, except for a high-quality RCT during the proposal, can get a listing for their DiGA if the concept is likely to succeed. However, it should be considered that manufacturers have an immense financial risk if they fail to proof the positive care effects with rigorously conducted RCTs within one year or if there DiGA price will be upgraded after the test phase; also, no DiGA gets a listing by the BfARM, even not provisionally, if no sufficient data for its efficacy from pilot studies or data security standards were not met [8]. However, long-term effects and adherence amongst various patient groups should be monitored given that the DiGA concept is rather novel. Particularly**,** the outbreak of the COVID-19 pandemic and the accompanying need to quickly switch to contactless health care made it clear that lacking acquaintance with DMHIs is a key barrier to their implementation in healthcare [12]**.** Therefore, the development of user-centered, context-sensitive information strategies for relevant target groups represent a crucial step during the slow innovation diffusion process [13].

When analyzing preferences regarding information strategies on DMHIs, medical students represent a special population of interest, not only because they potentially prescribe DMHIs in their role as future physicians, they also belong to a vulnerable group in terms of a high prevalence of CMDs and often exhibit poor help-seeking behavior when in need [14–16]. Fear of stigmatization in medical school and expected career disadvantages if mental health issues are disclosed appear to be widespread reasons for not seeking support [17].

To inform patients and (future) HCPs about DMHIs, acceptance-facilitating interventions (AFIs) have been suggested as information strategies in earlier stages of innovation diffusion [18]**.** AFIs typically consist of multiple components, such as narrative messages (e.g., experts´ recommendations), information on quality criteria, including the scientific evidence base, as well as the use of different media formats ranging from text-based information to video material [19]**.**

Besides insignificant results in some studies on the effects of AFIs [20–22], different experiments have shown that AFIs can foster the acceptance of DMHIs among individuals with CMDs [23,24], students with or without mental health issues [25] and psychotherapists [18].
However, the optimal composition of multi-attribute AFIs for providing DMHI information is difficult to determine with commonly used survey methods that do not require respondents to make tradeoffs between the components they prefer the most. Discrete choice experiments (DCEs) offer the possibility to investigate complex hypothetical choices of information strategies [26] by involving combinations of various information attributes, varying in attribute levels, and by controlling for interactions.
To our knowledge, only few DCEs examined information preferences on mental health services (e.g., [27]), but none of them focused on DMHIs. Further, while prior DCEs have focused on preferences regarding the delivery of DMHIs in the general population and among HCPs in Germany (see, Phillips et al. [28,29]), little is known about the specific information preferences regarding DMHIs in medical students.

This DCE aims to examine information preferences on DMHIs for personal use among medical students in Germany. For this purpose, three research questions (RQ) were formulated:
RQ1) What is the preferred information strategy regarding DMHIs (i.e., AFIs) in medical students?
RQ2) What are the most important attributes of information strategies?
RQ3) Does preference heterogeneity exist regarding information strategies?

Methods

Ethical considerations

The ethics committee of the Faculty of Medicine at the Heinrich Heine University Düsseldorf approved the DCE in August 2022 (approval: no. 2022-2102).
The DCE was conducted online and anonymously using Lighthouse Studio (Sawtooth Inc.). No identifying information, such as personal data or IP addresses, were recorded to ensure anonymity. To access the online survey, participants had to provide informed consent online (click-to-agree). Participants were able to quit the assessment whenever they wanted. As an incentive, participants could take part in a lottery (5* € 100, 30* € 50) upon study completion by saving a randomly created code consisting of numbers (e.g., via screen shot). No contact data was thus requested for participation in the lottery. This ensured anonymity of participation. The winning codes were published on the website of the institute in May 2023. The payment was handled by university staff not involved in the research.

Study design

The presented DCE was the main study of an exploratory mixed methods research approach. Next, we present the development of the DCE. Both study parts have been preregistered [30,31].

Following a sequential methodological approach and recommendations on the construction of DCEs according to the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) [32] and Hollin et al. [33], the DCE development was grounded in literature research and formative qualitative research.
The development consisted of the following six sequential steps:
1) Reviewing the research literature (for the research proposal)
2) Conducting semi-structured qualitative interviews

3) Conducting co-design workshops with medical and psychology students
4) Cognitive interviewing (concurrent think-aloud technique) and selection of attributes
5) Generating the experimental design
6) Technical pre-testing

Steps of DCE development

Preliminary work: literature research

Research objectives were defined based on the current literature (using electronic data bases, hand searching). In a first step, literature was searched to identify general information needs and preferences regarding DMHIs as well as potentially acceptance-facilitating features of information on DMHIs among university students as potential users. This was the basis for the research proposal to be funded by the Research Commission of the Medical Faculty at the Heinrich Heine University Düsseldorf (grant no.: 2020-60). As outlined in the introduction section, this step led to the decision to focus the study on students of healthcare-related subjects, and especially medical students. In addition, due to the fragmentary research on the topic a mixed-methods design was chosen. In a second step, findings were used to develop semi-structured topic guides for the qualitative interviews.

Qualitative interviews

To explore the specific needs and preferences of students related to healthcare across Germany, we conducted n=21 semi-structured individual online interviews until consensus and thematic saturation was achieved (n=16 medicine, n=5 psychology; 76% female; mean age=25.5 years, SD= 3.9) in August and September 2021 using videoconference software (Webex, Cisco Systems, San José, California, USA). The interviews were saved using a digital recorder device and had an average duration of 31.7 minutes (SD=10.3). The data were analyzed applying content analysis according to Mayring [34], using MAXQDA, version 2020 (Verbi, Cologne, Germany). Students indicated little knowledge and experience with DMHIs but positive attitudes towards their potential use. They were asked about their information preferences regarding design (e.g., text or video), content (e.g., data protection, costs) and source (e.g., university or doctor). We deductively derived four attributes of an information strategy: information source, delivery format, content preferences and general design preferences, varying in different attribute levels (for a detailed description, see [35]). The results were used to develop a preliminary set of choice tasks for the DCE to be tested in co-design workshops for comprehensibility, relevance, completeness and feasibility in the next step [26,32].
The interviews also addressed the setting in which participants would like to receive information about DMHIs. Medical students had preferred the university context in our prior work, which was therefore chosen as context in the DCE [detailed information, see [35–37]].

Co-Design Workshops

To involve the target group in the DCE design and to validate and refine the selection of attributes and levels, two participatory co-design workshops with n=8 university students (n=6 medicine, n=1 psychology, n=1 public health) were conducted in May and June 2022. The face-to-face workshops lasted about 90 to 120 minutes. Participants were asked to evaluate prepared choice tasks with respect to comprehensibility and cognitive effort. As a result of the workshops, we decided to focus on medical students only in the further preparation and realization of the DCE, because the two (non-medical) students expressed slightly different preferences for attributes and levels than medical students, which was interpreted in terms of their different study background. Furthermore, we made minor changes to the set of attributes, splitting content preferences into “recommendation” (e.g., HCPs, patients) and “quality criterion” (e.g., data security, scientific evidence base) and dropping

general design preferences, because it was rated least important. Furthermore, we added a new attribute called “timing” (e.g., freshman week, pre-clinic), which seemed to be of greater importance to participants.

Cognitive interviews

In July 2022, the preliminary DCE was discussed in cognitive interviews with N=5 respondents. Participation required informed consent. Using the concurrent think-aloud method, which is an established approach in usability research [38], respondents were asked to share their thoughts, while answering the survey including DCE tasks and instructions. The piloting lasted about 60 minutes per participant and aimed to check again for comprehensibility and to identify difficulties in processing. Gathered information only led to some minor rearrangements.

Experimental design

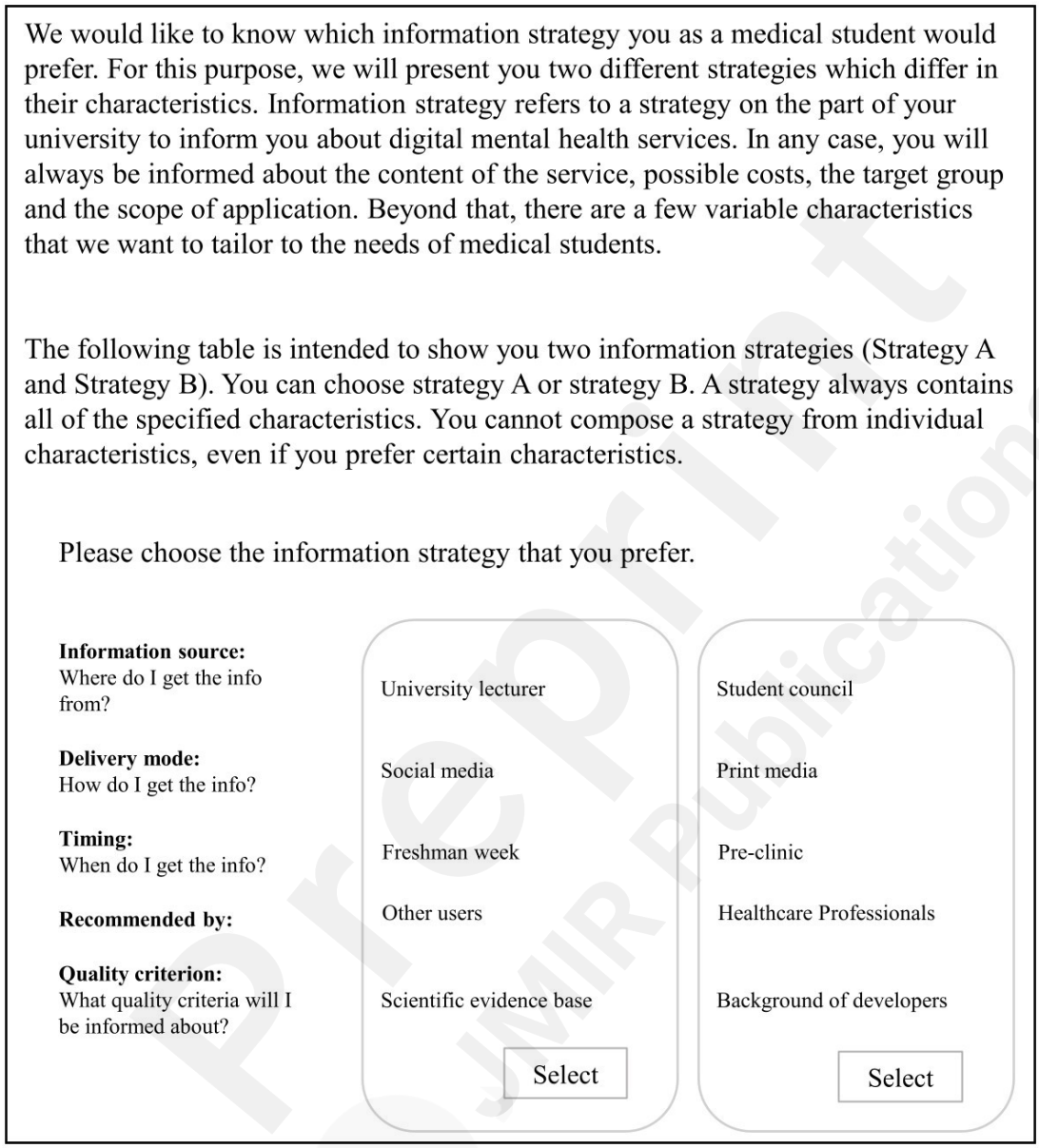
The experimental design was based on the decision by the research team to choose a set of attributes and levels following the qualitative research steps as well as plausibility considerations on combinations. The choice-sets did not include an opt-out option since we wanted to learn which information strategy is preferred by students given the university would decide to undertake an information campaign for DMHIs. A fractional factorial experimental design [39] was developed based on Kuhfeld [40] using the statistical software package SAS (SAS Software 9.4 (TS1M2), SAS Institute Inc., Cary, NC, USA, 2010-2012). The design allowed for an estimation of main effects, with all attributes coded categorically. D-efficiency was 16.029. We used effects variable coding according to Bech and Gyrd-Hansen [41]. In the end, the experimental design consisted of 24 choice tasks, which we divided into eight choice tasks administered in three blocks. Each choice set consisted of five attributes varying in three to four attribute levels.
Participants were randomly assigned to one of the three blocks. In each block, we repeated one of the choice tasks to test the internal validity of the experiment as a reliability test. To familiarize respondents with the DCE format, we provided a detailed explanation for each attribute and attribute level (see Table 1), followed by a written description of an exemplary information strategy and an example choice task (see Figure 1). Respondents were asked to choose the preferred information strategy to receive information about DMHIs. DMHIs were introduced as digital mental health services that can be used anonymously, from any location and at any time, e.g., to reduce stress or combat exam anxiety. It was explained that DMHIs refer to apps (DiGA), web applications, and psychological counselling via video conferencing. We did not employ an attribute for contents in this DCE due to anticipated heterogeneity in needs and knowledge [35].

Table 1. Final set of attributes and levels of the discrete choice experiment to investigate preferences regarding information strategies for digital mental health interventions among medical students in Germany.

Attribute	Level 1	Level 2	Level 3	Level 4	Description
Information source	Student council[a]	Student services centre	University lecturers		Medical students could be informed on DMHIs[d] by several organizational structures. Instances could be student council, the student services center and university lecturers.
Delivery mode	E-mail	Social media	Seminar	Print media	Medical students could receive information on DMHIs via different delivery modes. These include e-mail, the social media accounts of the university, such as Instagram, a seminar that is included in the curriculum and print media.
Timing	Freshman week[b]	Pre-clinic	Clinic	Practical year	Medical students could be informed about DMHIs by their university at different times. They could be informed right at the beginning of their studies during the freshman week, during the first stage of their studies (pre-clinic), during the clinical stage of their studies or at the end of their studies during their practical year.
Recommendation	HCP[c]	Users	Students	No recommendation	Information strategies on DMHIs may contain reviews or recommendations. These could come from healthcare professionals, such as physicians, other users or students. They also may not contain statements about whether a service is recommended or advertised by other groups of people.
Quality criterion	Data security	Scientific evidence base	Background of developers	Quality seal	Medical students could receive information about quality criteria to help them decide whether DMHIs meet a certain standard. These include information on specific measures to safeguard data security, the scientific evidence base or the professional background of the developers of a specific service. A quality seal informs if, for example, the university or a federal institute has received a quality certificate for its service.

[a]Student council: Members of the student council are students who were elected to represent their perspective and interests in medical school.
[b]Freshman week: In Germany, student councils introduce freshman to a variety of aspects of campus life over the course of the first week and provide orientation for medical studies. In this welcome week, many workshops and social activities are offered for new students.
[c]HCP = healthcare professionals.
[d]DMHIs = digital mental health interventions.

Figure 1. Instruction and exemplary choice task of the discrete choice experiment to investigate preferences regarding information strategies for digital mental health interventions among medical students in Germany.



Technical pre-test

Finally, technical pre-tests of the first version of the programmed online DCE with three feedback rounds (for iterative improvement) were conducted with n=12 respondents from the institute of the principal investigator (e.g., master's students, doctoral students, research associates) and with two external medical students (personal contacts) in November and early December 2022. Technical pre-testing resulted in several minor formal refinements of the survey interface. Based on the pre-test, the time required to complete the complete questionnaire (including the DCE and the questionnaire) was expected to be 15-20 minutes as planned.

Besides the DCE (incl. instructions), study information and informed consent the final online survey asked for the following background information:

- Demographic characteristics (gender, age, German state of the university)
- Studies (number of semesters, passed exams – up to three in Germany until approbation)

- Familiarity with DMHIs (if they have heard of DMHIs before)
- Attitudes towards potential use (how often they would like to use DMHIs; minutes a day and days a week)
- Willingness to pay for DMHIs (preferred mode of payment, amount of money willing to pay)
- Self-assessed stress in the previous and current semester using a visual analogue scale (VAS) [42] ranging from 0 (min.) to 10 (max.)

Recruitment and data collection

Medical students who stated that they were at least 18 years old and enrolled at a medical school in Germany were able to participate in the anonymous online study by accessing a link to the survey website (e.g., via QR-Code). We followed a convenience sampling strategy, which means participants were recruited via social media and e-mail (via student councils), personal contacts (e.g., face-to-face, WhatsApp personal chat and chat groups), printed flyers and posters at different universities across Germany. We also involved lecturers to promote the study (showing slides with a QR code and link to the DCE in their presentation slides). We were also supported by the Study Dean of our Faculty of Medicine, including survey invitations sent via e-mail to different semesters in April 2023.
Data collection took place from December 10th, 2022 until May 2nd, 2023, once the required number of participants was reached. A sample size of n>125 medical students was targeted to provide sufficient statistical power for the main analysis and several subgroup analyses based on a rule of thumb formula proposed by Johnson and Orme [43].

Statistical Analysis

Based on the technical pre-tests of the online survey, it was assumed that a minimum processing time of five minutes is required to read the instructions and complete the DCE tasks properly, whereby five minutes was a rather conservative estimation of the minimum processing time. No participant of the pre-test was able to complete the DCE in under five minutes. For participants with lower processing time, we expected an insufficient engagement with the DCE and excluded them from the analysis (i.e., hard cut-off criterion). Since participants with processing time below 5 minutes may choose randomly and thus would increase the error term of the analytical models. Moreover, participants who answered less than half of the choice-sets (<4) were also excluded. Furthermore, the main analysis was based on respondents who passed the reliability test exclusively. The reliability test was passed if a repeated ninth control choice set was answered identically (i.e., one choice set with strategy A and B swapped was repeated). Descriptive analysis for individual characteristics of the complete sample and participants that passed and did not pass the reliability test, respectively, were performed.
DCE data were analyzed employing logistic regression models. In particular, we ran a conditional logit model clustered at the individual level to receive preference weights of levels as well as the relative importance of attributes. Since the scale of coefficients is arbitrary, attributes are only comparable in relation to each other [44], using the relative importance of attributes.

In a second step, we considered possible preference heterogeneity by using a latent class analysis (LCA) model. The optimal class size was determined by the Bayesian Information Criterion (BIC) and consistent Akaike Information Criterion (cAIC). Classes were described by their preference weights and relative importance of attributes. We also calculated posterior probabilities for being a member of a class for each participant. Respondents were assigned to the class with the higher posterior probability, and we compared individual characteristics of

the assigned participants across classes descriptively. The analysis was performed with Stata® 15 (StataCorp LLC, Texas). The significance level for statistical tests was alpha error probability of $\alpha < .05$.

Results

Descriptive and preliminary analysis

The online survey was accessed 749 times. Of the 428 participants who gave informed consent, 97 needed a processing time of less than five minutes to complete the survey and were thus excluded from the analysis. Of those 97 participants who showed a processing time below five minutes 66 participants did not complete at least one choice set and another five respondents did complete less than four choice-sets. Of the remaining 331 individuals, 309 respondents answered four or more choice-sets of the DCE. In detail, those respondents who answered more than half of the choice-sets completed all choice-sets. Of those individuals who answered less than four choice-sets, two participants answered two choice-sets, one participant answered one choice-set and 19 participants answered no choice-set at all. The reliability test was passed by 231 (74.76%) of 309 participants (i.e., complete sample). To describe choice making behaviour in the DCE in greater detail, we provide a lexicographic score analysis similar to Phillips et al. [28], as shown in Multimedia Appendix 2.

Characteristics of the sample are provided in Table 2 for the complete sample (N=309), as well as for participants who passed and did not pass the reliability test, respectively (n=231, n=78).

Table 2: Individual characteristics of the full study sample, a sample with participants who passed and a sample with participants who did not pass the reliability test (passed if a repeated ninth control choice set was answered identically in the discrete choice experiment).[a]

Variables	**Full sample (N = 309)**	**Passed reliability test (n = 231)**	**Did not pass reliability test (n = 78)**	**Test[b] (*P value*)**
Gender, n (%)				1.00[c]
Women	217 (70.23%)	162 (70.13%)	55 (70.51%)	
Men	91 (29.45%)	68 (29.44%)	23 (29.49%)	
Non-binary / third gender	1 (0.32%)	1 (0.43%)	0 (0.00%)	
Age, mean (SD)[e]				.88[d]
	24.05 (3.95)	24.05 (3.91)	24.03 (4.09)	
Semesters, mean (SD)				.75[d]
	7.12 (3.40)	7.16 (3.37)	6.99 (3.51)	
Passed exams, n (%)[f]				.95[c]
No passed exam	113 (36.57%)	85 (36.80%)	28 (35.90%)	
M1 exam	151 (48.87%)	113 (48.92%)	38 (48.72%)	
M2 exam	43 (13.92%)	31 (13.42%)	12 (15.38%)	
M3 exam	2 (0.65%)	2 (0.87%)	0 (0.00%)	
Self-assessed stress – previous semester, n (%)				.32[c]
0 = "no stress at all"	0 (0.00%)	0 (0.00%)	0 (0.00%)	
1	11 (3.56%)	10 (4.33%)	1 (1.28%)	

2	8 (2.59%)	7 (3.03%)	1 (1.28%)	
3	33 (10.68%)	24 (10.39%)	9 (11.54%)	
4	25 (8.09%)	15 (6.49%)	10 (12.82%)	
5	21 (6.80%)	18 (7.79%)	3 (3.85%)	
6	31 (10.03%)	19 (8.23%)	12 (15.38%)	
7	61 (19.74%)	46 (19.91%)	15 (19.23%)	
8	62 (20.06%)	48 (20.78%)	14 (17.95%)	
9	34 (11.00%)	28 (12.12%)	6 (7.69%)	
10 = "very stressed"	23 (7.44%)	16 (6.93%)	7 (8.97%)	
Self-assessed stress – currently, n (%)				.33[c]
0 = "no stress at all"	23 (7.44%)	17 (7.36%)	6 (7.69%)	
1	24 (7.77%)	20 (8.66%)	4 (5.13%)	
2	47 (15.21%)	36 (15.58%)	11 (14.10%)	
3	37 (11.97%)	23 (9.96%)	14 (17.95%)	
4	25 (8.09%)	16 (6.93%)	9 (11.54%)	
5	26 (8.41%)	19 (8.23%)	7 (8.97%)	
6	27 (8.74%)	19 (8.23%)	8 (10.26%)	
7	39 (12.62%)	32 (13.85%)	7 (8.97%)	
8	31 (10.03%)	22 (9.52%)	9 (11.54%)	
9	13 (4.21%)	11 (4.76%)	2 (2.56%)	
10 = "very stressed"	17 (5.50%)	16 (6.93%)	1 (1.28%)	
Being aware of DMHIs, n (%)				
	98 (31.72%)	75 (32.47%)	23 (29.49%)	.68[d]
Expected frequency of use – days per week, mean (SD)				
	2.21 (1.60)	2.20 (1.62)	2.27 (1.54)	.61[d]
Expected frequency of use – minutes per day, mean (SD)				
	21.42 (16.49)	21.21 (15.53)	22.05 (19.16)	.599[d]
Willingness to pay, mean (SD)				
	25.72 (60.38)	22.76 (21.99)	34.46 (114.17)	0.50[d]

[a]No missing data in individual characteristics.
[b]Test for differences in individual characteristics for participants who passed the reliability test and those who did not pass the reliability test.
[c]Fisher's exact test
[d]Mann-Whitney-U test.
[e]SD = standard deviation.
[f]M1-M3 = first to third state exam in medical schools in Germany.

The majority of participants in the full sample with N=309 were women (approximately 70%), on average roughly 24 years old (SD=4.0) and studied in their 7th semester (M=7.1, SD=3.4). The mean age of men (M=25.7 years, SD=4.4) was significantly older than for women (M=23.3 years, SD=3.5) in the full sample (Mann-Whitney U Test: $P < .001$), which also corresponds to a significantly higher mean semester for men than for women (M=7.9, SD=3.1 vs. M=6.8, SD=3.5 semesters, Mann-Whitney U Test: $P = .006$). Approximately one third of the university students in the complete sample passed no major exam to date (36.6%), while nearly one half passed the M1 exam (48.9%), which is the first state exam in medical

studies and takes place after completion of the pre-clinical phase. The distribution of self-assessed stress during the previous semester was left-tailed with a majority of students (68.3%) who indicated 6 to 10 on the 10-point rating scale, which might be interpreted as feeling moderately to severely stressed. In comparison to stress in the previous semester, the current self-assessed stress has shifted to lower stress levels (only 41.1 % indicated a 6 to 10).
Of all participants, n=98 (31.7%) indicated being aware of DMHIs. On average participants were willing to use DMHIs two days per week (M=2.2, SD=1.6) and 21 minutes per day (M=21.4, SD=16.5). As most preferred payment mode, 93.2% of students agreed on free offers. Nonetheless, the mean willingness to make a one-time payment for DMHI service was M=25.7 € (SD=60.4). A detailed analysis of the willingness to pay (WTP) is provided in Multimedia Appendix 3.
Comparing individuals with a reliable vs. a non-reliable response pattern according to their characteristics, no significant differences were detected (all with P>.05). In the following analysis, only participants who passed the reliability test were included. Yet, the results of the complete sample analysis are similar to the results based on the sample of respondents who passed the reliability test (see Multimedia Appendix 4). Also, a Swait-Louviere test [45] indicated that while preferences were not significantly different for people who passed and did not pass the reliability test at the 5% significance level (H0a: P = 0.178), it also showed that the scale parameter differed significantly (H0b: P = 0.003).

Main findings

Table 3 shows the conditional logit regression results for respondents who passed the reliability test (n=231).

Table 3: Conditional logit regression results of the discrete choice experiment, showing significant attributes and levels as well as the relative importance of attributes in comparison.

Attributes and Levels	**Coefficient (SE)**[a]	**95% CI**[b]	**Relative Importance**
Information Source			9.22%
Student Service Centre	-0.04 (0.05)	[-0.13, 0.06]	
Student Council	0.17 (0.05)	[0.07, 0.28]	
University Lecturers	-0.14 (0.04)	[-0.22, -0.05]	
Delivery Mode			24.44%
Social Media	0.27 (0.06)	[0.15, 0.39]	
E-Mail	0.16 (0.06)	[0.05, 0.27]	
Seminar	0.12 (0.07)	[-0.02, 0.25]	
Print Media	-0.55 (0.07)	[-0.68, -0.42]	
Timing			32.59%
Freshman Week	0.31 (0.06)	[0.19, 0.42]	
Pre-Clinic	0.50 (0.06)	[0.38, 0.62]	
Clinic	-0.20	[-0.31, -0.10]	

	(0.05)		
Practical Year	-0.60 (0.07)	[-0.73, -0.47]	
Recommendation			19.09%
HCP[c]	0.14 (0.05)	[0.04, 0.24]	
Students	0.29 (0.05)	[0.18, 0.39]	
Users	-0.07 (0.05)	[-0.16, 0.02]	
No Review	-0.35 (0.06)	[-0.47, -0.24]	
Quality Criterion			14.66%
Data Security	-0.12 (0.06)	[-0.24, -0.01]	
Evidence-Based	0.30 (0.06)	[0.18, 0.41]	
Quality Seal	0.02 (0.05)	[-0.08, 0.12]	
Background of Developers	-0.20 (0.06)	[-0.31, -0.08]	

[a]SE = standard error.
[b]CI = confidence interval; significance is assumed if the confidence interval does not include the number zero (no different signs).
[c]HCP = healthcare professionals.

Medical students significantly preferred to receive information about DMHIs from the student council and significantly refused to receive information from university lecturers. As delivery mode, participants wanted to get the information delivered via social media and e-mail and did not want to receive the information via print-based media. Students had significant positive preference weights for receiving the information about DMHIs during their pre-clinic phase or in the freshman week and significant negative preference weights for the practical year.
The recommendation should be given by other students or healthcare professionals, while no recommendation was rated negatively.
As a quality criterion, medical students significantly preferred information about the evidence-based background of DMHIs. Data security and background of developers showed significant negative preference weights.

With 32.6%, the most relevant attribute for medical students was timing (i.e., time point in their studies when the information is shared). In addition, the attributes delivery mode (24.4%) and recommendation (19.1%) showed a high relative importance as well. The attributes quality criterion (14.7%) and information source (9.2%) were less important for medical students.
To account for preference heterogeneity, we employed a LCA. Results for respondents who passed the reliability test (n=231) are shown in Table 4. The optimal number of classes was determined by the BIC and cAIC, which were minimized at two classes (see Multimedia Appendix 5).

Table 4: Latent class model regression results of the discrete choice experiment, showing significant attributes and levels as well as the relative importance of attributes in comparison for two identified groups varying in information preferences.

Attributes and Levels	Class 1 (n=147)			Class 2 (n=84)		
	Coefficient (SE)[a]	95% CI[b]	Relative Importance	Coefficient (SE)	95% CI	Relative Importance
Information Source			1.49%			24.21%
Student Service Centre	-0.03 (0.07)	[-0.18, 0.11]		-0.07 (0.13)	[-0.32, 0.18]	
Student Council	0.03 (0.07)	[-0.12, 0.18]		0.56 (0.25)	[0.07, 1.04]	
University Lecturers	0.00 (0.07)	[-0.14, 0.14]		-0.49 (0.26)	[-0.99, 0.02]	
Delivery Mode			35.49%			42.86%
Social Media	0.09 (0.10)	[-0.10, 0.29]		0.67 (0.19)	[0.29, 1.05]	
E-Mail	-0.09 (0.09)	[-0.27, 0.08]		0.74 (0.29)	[0.17, 1.31]	
Seminar	0.76 (0.13)	[0.51, 1.01]		-1.11 (0.38)	[-1.85, -0.36]	
Print Media	-0.77 (0.11)	[-0.98, -0.55]		-0.31 (0.49)	[-1.27, 0.65]	
Timing			21.27%			46.11%
Freshman Week	0.14 (0.08)	[-0.02, 0.29]		0.86 (0.32)	[0.24, 1.48]	
Pre-Clinic	0.48 (0.11)	[0.27, 0.69]		0.71 (0.31)	[0.09, 1.32]	
Clinic	-0.18 (0.09)	[-0.36, -0.003]		-0.43 (0.18)	[-0.78, -0.09]	
Practical Year	-0.44 (0.10)	[-0.63, -0.24]		-1.13 (0.46)	[-2.02, -0.24]	
Recommendation			19.73%			4.02%
HCP[c]	0.22 (0.09)	[0.04, 0.40]		-0.03 (0.33)	[-0.68, 0.62]	
Students	0.35 (0.09)	[0.17, 0.54]		0.04 (0.18)	[-0.32, 0.39]	
Users	-0.07 (0.08)	[-0.23, 0.09]		0.08 (0.32)	[-0.55, 0.72]	
No Review	-0.50 (0.06)	[-0.61, -0.38]		-0.09 (0.45)	[-0.97, 0.79]	
Quality Criterion			22.02%			19.10%
Data security	-0.39 (0.09)	[-0.56, -0.22]		0.37 (0.26)	[-0.15, 0.88]	
Evidence-Based	0.56 (0.10)	[0.35, 0.76]		0.00 (0.18)	[-0.37, 0.36]	
Quality Seal	-0.04 (0.08)	[-0.20, 0.13]		0.09 (0.14)	[-0.19, 0.38]	
Background of Developers	-0.13 (0.05)	[-0.23, -0.03]		-0.46 (0.28)	[-1.00, 0.08]	

[a]SE = standard error.
[b]CI = confidence interval.
[c]HCP = healthcare professionals.

When assigning participants based on their posterior probabilities, we found that nearly two thirds (n=147, 63.6%) could be allocated to class 1 (labelled “seminar-based information strategy”) and one third (n=84, 36.4%) to class 2 (referred to as “early digital information strategy”). The two classes differed considerably in their preference patterns as well as in their relative importance of attributes. For class 1, the most important attribute was the delivery mode (approx. 36%) with seminar as most preferred level. The attributes quality criterion, timing, and recommendation had similar shares of relative importance, approx. 20% each. In particular, preferences of class 1 showed that information about the evidence base of DMHIs should be used as quality criterion, information should be provided during the pre-clinic phase, and recommendations for DMHIs should be given by students or HCPs. Information source was the least important attribute of class 1 (approx. 1%). According to the relative importance of attributes for class 2, timing (approx. 46%) and, with comparable relative importance, delivery mode (approx. 43%) were the most important attributes. Class 2 showed a strong preference for receiving the information about DMHIs early during their studies (pre-clinic phase or freshman week) and preferred receiving the information via e-mail or social media. The attribute information source showed a relative importance of approximately 24% with student council as preferred level. Regarding the attribute quality criterion (approx. 19%) data security was preferred by class 2 (not significant). The attribute recommendation was the least relevant attribute for class 2 (approximately 4%).
We compared individual characteristics of members of class 1 and class 2, respectively, and found no significant differences (all with $P<.05$), except for being familiar with DMHIs (see Multimedia Appendix 5). In detail, members of class 1 were significantly more familiar with DMHIs than members of class 2 (37.4% vs. 23.8%).

Discussion

In this study, we conducted a DCE to investigate information preferences regarding DMHIs for personal use among medical students in Germany. We aimed to derive a preferred information strategy and aimed to identify its most important features. In addition, we investigated whether there are latent classes among medical students that differ in information strategy preferences.

Preferred information strategy and relative importance of features

In the following, the results regarding the various features of the preferred information strategy are discussed one by one. It is important to consider that participants thought about self-use, as indicated in the introduction. When addressing them as future physicians, results may be different.

Medical students preferred to be informed early in the freshman week or the pre-clinical phase of their studies. Potentially, medical students (mean semester was 7), had already experienced study-related mental health issues themselves or had seen such issues in their peers, which might lead to a preference for early information. Indeed, a meta-analysis indicated increased prevalence rates of mental health problems, especially in younger and pre-clinical students [16]. At best, the timing for information should be chosen when students feel mentally healthy or when academic distress has not already contributed to manifested health issues requiring interventions.

Information via social media and e-mail were favored compared to print-based media. Potentially, this reflects the habits and preferences of younger adults and digital natives included in our study. However, the research literature on the preferences of digital resources

of healthcare students belonging to so-called Generation Z is interestingly limited and inconsistent [46]. Additionally, in our study participants even clearly refused to receive information via print media (e.g., flyers). A possible explanation is the immense exposition to printed information in medical schools. Students have to read and learn a lot of complex contents mainly from textbooks in a very short time for exam preparation. Maybe, they do not want the same modality of delivery that is regularly associated with study, work or even stress for information concerning the promotion of their mental health. Another disadvantage of print media could be that it is visible to others when someone receives information via, e.g., flyer or brochure. In contrast, brief information delivered digitally could be perceived as more pleasant (e.g., a short video) and are easy to access whenever needed in daily life. Furthermore, the DCE was conducted about three years after the beginning of the COVD-19 pandemic, which led to the extension of e-learning in medical education. Elevated familiarity with digitally provided, approved health information in recent years may have increased the acceptance of digital information channels for other contexts [47]. Of course, students generally vary in learning preferences and learning styles [48] while research on learning styles in particular has been subject to controversy in terms of its evidence base and practical usefulness in medical education [49]. Therefore, we focused on stated preferences as well-researched construct in the investigation of user-centered information strategies. However, we could only consider previously identified attributes and levels that may alter over time regarding their relevance for the target group with changing consumer habits and experiences. Future DCEs should explore which channel of social media (e.g., Instagram, TikTok) and which presentation format (e.g., video, interactive sessions) should be used to disseminate information on DMHIs.

Participants liked to receive recommendations by other students and HCPs. Both students and HCPs appeared suitable as role models (see, social-cognitive theory [50]) and trusted sources. Possibly, students preferred these sources as they are similar to themselves now (i.e., as students) and hypothetically in the future (i.e., as physicians), as different empirical investigations on the impact of narratives from individuals with a similar background on decision making in healthcare contexts indicated [51,52]. Nonetheless, influences of recommendations are highly context-sensitive.
For instance, in a DCE with young adults conducted by Cunningham et al. [27], those who wanted to be informed digitally preferred recommendations by other young adults with previous experiences of depression and anxiety, while those who wanted to be informed conventionally via traditional media channels liked to receive recommendations from medical physicians. Hence, information features should be tailored to the preferences of the target group including subgroups differing in information preferences (see, LCA results below). Although testimonials are commonly used in DMHI advertisements, it remains unclear how useful recipients view such recommendations as features of information or if the advertisements have an influence on the uptake of DMHIs [22]. Therefore, the integration of recommendations should be carefully chosen in dialogue with the key target group for the information distribution. In future studies, it would be interesting to investigate the characteristics of recommendations that students perceive as trustworthy (e.g., those with own experience with mental health issues).

Regarding quality criteria, medical students significantly preferred information about the evidence-based background of DMHIs. Data security and background of developers showed significant negative preference weights. Students expected the information to be provided by the university (as stated in the DCE's instructions), maybe assumed that the offerings were already quality tested and therefore focused on other quality criteria than they would be interested in in another setting. Addressed in their role as future professionals, preferences

might differ and participants may place more emphasis on information on the evidence base or data security for professional use (e.g., [35,36]).

Medical students preferred to receive information about DMHIs from their student council. Medical students even refused to receive information from university lecturers. With respect to mental health topics, students may have a higher trust in students´ representatives as peers and may worry about stigmatization by lecturers if they disclose their need for support.

Subgroup-specific information strategies

Latent class analysis identified two distinct groups of students that differed considerably in their information preferences. Class 1, which we classified as "seminar-based information strategy", preferred to receive information about DMHIs in a face-to-face seminar in the pre-clinic phase. Moreover, they preferred to obtain recommendations from other students, while information about the evidence base of DMHIs should serve as key quality criterion. Except for the delivery mode (seminar), preferences of class 1 were similar to the overall preferences of participants regarding DMHI information strategies, which can be well explained by the fact that the majority (i.e., 63.64%) could be classified as members of class 1.
In contrast, the ideal information strategy of class 2 ("early digital information strategy") would be to provide information by the student council via social media or by e-mail. Regarding the timing of information, class 2 preferred to receive them as early as possible, i.e., during the freshman week (prior to the actual start of studies). The attributes quality criteria and recommendation were less important for class 2 than for class 1, findings were insignificant. Members of class 2 were significantly less familiar with DMHIs than members of class 1. Hence, they may want to be initially informed at a low threshold. In prior qualitative studies with medical students, they expressed the wish to get quick support by interventions that are easy to access in times of study-related distress, e.g., services targeting stress and time management [36,53]. Furthermore, we did not find any significant differences (e.g., in stress levels) in the individual characteristics of members of class 1 and class 2.
However, preferences of class 1 and 2 should be not viewed as divergent strategies but may help to develop complementary stepped or matched approaches. For instance, digitally provided information could be the first step that might lead to further information-seeking behavior and the attendance of seminars about DMHIs. A combination of both strategies should be used in order to reach a higher number of medical students throughout Germany. Specifically, the digital strategy, which is in line with the overall preference, represents a way to reach a broad range of medical students, especially those with little knowledge or no currently perceived need for DHMIs.
Besides the DCE, our study provided new insights into the willingness to pay for DMHIs, which should also be considered by universities when informing about interventions. In particular, medical students stated being willing to pay € 22.7 as a unique fee on average to use DMHIs.

Limitations

A key limitation was that we recruited medical students mainly via one channel, namely personal invitations (e.g., chat groups, e-mails from student councils), as postings in social media groups (e.g., on Facebook) as well as flyers on campus across different universities were much less effective in terms of recruitment success. Nonetheless, the sample seems to be similar to the overall population of medical students in Germany regarding their individual characteristics, such as age and gender (e.g., [54]).
Another limitation was that students could participate during the semester and in the semester break. Information preferences regarding mental health services might differ depending on the time of participation and related needs and stress levels (e.g., in times of exams, semester

appointments). Specifically, increased perceived stress may indicate personal need or relevance of mental health information and thereby foster the motivation to seek information on coping strategies, which may be related to more interest in easily accessible support services, such as DMHIs.

However, our study can only provide very limited information on whether or how emotional distress may have influenced DMHI information preferences. Due to ethical aspects and to keep the (emotional) response burden as low as possible, we refrained from using clinical screening measures on CMDs in this study. A future DCE could put a greater emphasis on information preference on DMHIs for self-help and adjunctive treatment, which could include the assessment of different mental health conditions.

A further limitation was that the majority of participants have not heard of DMHIs before, which is similar to prior studies with students from our work group [36,55–57], but may have resulted in difficulties in decision making and thus contributed to heuristic decisions (e.g., finding student councils more appealing than lectures and thus wanting them as information source).

It should be noted that there was no opt-out option given to respondents, which corresponds to the real world setting of students receiving information by a university information campaign. However, our results may be biased to some extent as students not wanting to receive information may differ in their preferences from those wanting to receive information.

Finally, a few thoughts on the selected attributes and levels. Concerning the level "seminar", belonging to the attribute "delivery mode", further information on the organization of a seminar (e.g., block seminar, face-to-face seminar, online seminar) would be desirable. Further research should clarify the preferences of medical students regarding the design of seminars about DMHIs (e.g., mode, duration, topic).

Lastly, there might be a lack of selectivity in the attribute levels "students" and "users" regarding the attribute "recommendation" because students can also be users at the same time. However, due to the different assessments (with other students being a significant recommendation source) it seems that the participants viewed those attributes differently and therefore this limitation may not be severe. Future DCEs could use additional qualitative methods to prevent such potential sources of bias (e.g., by more detailed descriptions of prototypical users or personas to be developed with the target group).

Conclusions

Overall, the study findings suggest potentially suitable, distinct general and subgroup-specific information strategies on DMHIs for medical students in Germany. Designing information strategies according to the stated preferences could help to increase DMHIs utilization. This DCE offers a variety of possible features to be tested in practice. As a first step, AFI strategies could start to promote the awareness of or basic knowledge on DMHIs for health promotion purposes with a social media campaign with relation to their university setting early in their studies. The campaign could be provided by the student council, combining recommendations and information about the scientific evidence as complementary features. This low-threshold offer could lead to students attending seminars on DMHIs involving more detailed knowledge in a second step. Seminars should firmly be anchored in the curriculum of the Medical Faculties in accordance with the mandatory German National Competency-Based Learning Objective Catalogue of Medicine, in which digital competencies were not listed for too long [58], but are now, albeit to a limited extent.

Acknowledgments

This DCE was funded as main part of a mixed methods study (sub-project: “eMent-In-form-DCE”) by internal funds for Young Investigators of the Research Commission (German: “Forschungskommission”; FoKo) of the Faculty of Medicine at the Heinrich Heine University

Düsseldorf (proposal no.: 2020-60; granted for the project lead: Dr. Jennifer Apolinário-Hagen).
We thank the Open Access Funds of the Heinrich Heine University Düsseldorf and the Faculty of Medicine for funding the open access publication fees. We also cordially thank Sawtooth Inc. for supporting our DCE with a PhD grant (Pia Hüter M.Sc. née Braun) with a free licence to their software program Lighthouse Studio to program, host and administer the DCE.
We also thank the staff of the Study Dean of the Faculty of Medicine at the Heinrich Heine University Düsseldorf, Fatma Sahan B.Sc. Psych., Lisa Guthardt M.A., Dr. Thomas Muth, Fiona Kohl MPH, Susan Gritzka M.Sc. Psych., Anna Siegel-Kianer and several Student Councils (e.g., Düsseldorf, Jena, Essen, Münster) for their support with the recruitment of the sample. We also thank Dr. Ann-Kathrin Schwientek MPH for her substantial contribution to the interview study (planning, conduction, analysis), which served as the basis for the DCE.

Data availability

Data can be provided for non-commercial purposes on request by the principal investigator (Dr. Jennifer Apolinário-Hagen, e-Mail: digital.health@hhu.de).

Conflict of interest

The authors declare no conflicts of interest.

Author contributions

MV: Conceptualization, Formal Analysis, Methodology, Visualization, Writing – Original Draft Preparation
JB: Formal Analysis, Investigation, Visualization, Writing – Original Draft Preparation
PH: Conceptualization, Investigation, Software, Visualization, Writing – Review & Editing
SS: Investigation, Software, Writing – Review & Editing
BH: Methodology, Writing – Review & Editing
AL: Conceptualization, Methodology, Writing – Review & Editing
AI: Conceptualization, Writing – Review & Editing
SC: Investigation, Writing – Review & Editing
LS: Investigation, Writing – Review & Editing
CP: Conceptualization, Writing – Review & Editing
NKS: Methodology, Writing – Review & Editing
PA: Conceptualization, Resources, Writing – Review & Editing
JAH: Conceptualization, Funding Acquisition, Methodology, Project Administration, Validation, Writing – Original Draft Preparation

Multimedia Appendix 1

Choice making behavior - lexicographic scores.

Multimedia Appendix 2

Willingness to pay for digital mental health interventions (DMHIs).

Multimedia Appendix 3

Results of the complete sample analysis.

Multimedia Appendix 4

Further information on latent class analysis.

References

1. Borghouts J, Eikey E, Mark G, Leon C de, Schueller SM, Schneider M, Stadnick N, Zheng K, Mukamel D, Sorkin DH. Barriers to and Facilitators of User Engagement With Digital Mental Health Interventions: Systematic Review. J Med Internet Res 2021;23(3):e24387. PMID:33759801
2. Heinig I, Wittchen H-U, Knappe S. Help-Seeking Behavior and Treatment Barriers in Anxiety Disorders: Results from a Representative German Community Survey. Community Ment Health J 2021;57(8):1505-1517. PMID:33471256
3. Tomczyk S, Schmidt S, Muehlan H, Stolzenburg S, Schomerus G. A Prospective Study on Structural and Attitudinal Barriers to Professional Help-Seeking for Currently Untreated Mental Health Problems in the Community. J Behav Health Serv Res 2020;47(1):54-69. PMID:31165415
4. Gaebel W, Lukies R, Kerst A, Stricker J, Zielasek J, Diekmann S, Trost N, Gouzoulis-Mayfrank E, Bonroy B, Cullen K, Desie K, Ewalds Mulliez AP, Gerlinger G, Günther K, Hiemstra HJ, McDaid S, Murphy C, Sander J, Sebbane D, Roelandt JL, Thorpe L, Topolska D, van Assche E, van Daele T, van den Broeck L, Versluis C, Vlijter O. Upscaling e-mental health in Europe: a six-country qualitative analysis and policy recommendations from the eMEN project. European archives of psychiatry and clinical neuroscience 2020. PMID:32393997
5. Ebert DD, Harrer M, Apolinário-Hagen J, Baumeister H. Digital Interventions for Mental Disorders: Key Features, Efficacy, and Potential for Artificial Intelligence Applications. Adv Exp Med Biol 2019;1192:583-627. PMID:31705515
6. Gagnon M-P, Sasseville M, Leblanc A. Classification of Digital Mental Health Interventions: A Rapid Review and Framework Proposal. Stud Health Technol Inform 2022;294:629-633. PMID:35612165
7. Gerlinger G, Mangiapane N, Sander J. Digitale Gesundheitsanwendungen (DiGA) in der ärztlichen und psychotherapeutischen Versorgung. Chancen und Herausforderungen aus Sicht der Leistungserbringer. [Digital health applications (DiGA) in medical and psychotherapeutic care. Opportunities and challenges from the perspective of the healthcare providers]. Bundesgesundheitsbl 2021;64(10):1213-1219. PMID:34550412
8. Heimann P, Lorenz N, Blum N, Schifferings C. Erfahrungen von Herstellern digitaler Gesundheitsanwendungen (DiGA) mit dem Fast-Track-Verfahren des BfArM. [Experiences of digital health care applications (DIGA) manufacturers with the BfArM Fast-Track procedure]. Bundesgesundheitsbl 2021;64(10):1249-1253. PMID:34542649
9. Wangler J, Jansky M. Digitale Gesundheitsanwendungen (DiGA) in der Primärversorgung – Erfahrungen und Beobachtungen von Hausärzt*innen hinsichtlich der Anwendung von DiGA. Prävention und Gesundheitsförderung 2022. doi:10.1007/s11553-022-00988-4
10. Dahlhausen F, Zinner M, Bieske L, Ehlers JP, Boehme P, Fehring L. Physicians' Attitudes Toward Prescribable mHealth Apps and Implications for Adoption in Germany: Mixed Methods Study. JMIR mHealth and uHealth 2021;9(11):e33012. PMID:34817385
11. Schlieter H, Kähling M, Hickmann E, Fürstenau D, Sunyaev A, Richter P, Breitschwerdt R, Thielscher C, Gersch M, Maaß W, Reuter-Oppermann M, Wiese L. Digitale Gesundheitsanwendungen (DiGA) im Spannungsfeld von Fortschritt und Kritik : Diskussionsbeitrag der Fachgruppe „Digital Health“ der Gesellschaft für Informatik e. V. [Digital health applications (DiGA) in the area of tension between progress and criticism : Discussion paper from the "Digital health" specialist group of the German Informatics Society]. Bundesgesundheitsbl 2024;67(1):107-114. PMID:38086924
12. Torous J, Jän Myrick K, Rauseo-Ricupero N, Firth J. Digital Mental Health and COVID-19: Using Technology Today to Accelerate the Curve on Access and Quality Tomorrow. JMIR Ment Health 2020;7(3):e18848. doi:10.2196/18848
13. Rogers EM. Diffusion of preventive innovations. Addictive behaviors 2002;27(6):989-993. PMID:12369480
14. Rotenstein LS, Ramos MA, Torre M, Segal JB, Peluso MJ, Guille C, Sen S, Mata DA. Prevalence of Depression, Depressive Symptoms, and Suicidal Ideation Among Medical Students: A

Systematic Review and Meta-Analysis. JAMA 2016;316(21):2214-2236. PMID:27923088
15. Quek TT-C, Tam WW-S, Tran BX, Zhang M, Zhang Z, Ho CS-H, Ho RC-M. The Global Prevalence of Anxiety Among Medical Students: A Meta-Analysis. International journal of environmental research and public health 2019;16(15). PMID:31370266
16. Peng P, Hao Y, Liu Y, Chen S, Wang Y, Yang Q, Wang X, Li M, Wang Y, He L, Wang Q, Ma Y, He H, Zhou Y, Wu Q, Liu T. The prevalence and risk factors of mental problems in medical students during COVID-19 pandemic: A systematic review and meta-analysis. Journal of affective disorders 2023;321:167-181. PMID:36341802
17. Shahaf-Oren B, Madan I, Henderson C. "A lot of medical students, their biggest fear is failing at being seen to be a functional human": disclosure and help-seeking decisions by medical students with health problems. BMC Med Educ 2021;21(1):599. PMID:34865636
18. Baumeister H, Terhorst Y, Grässle C, Freudenstein M, Nübling R, Ebert DD. Impact of an acceptance facilitating intervention on psychotherapists' acceptance of blended therapy. PloS one 2020;15(8):e0236995. PMID:32785245
19. Hein HJ, Glombiewski JA, Rief W, Riecke J. Effects of a video intervention on physicians' acceptance of pain apps: a randomised controlled trial. BMJ open 2022;12(4):e060020. PMID:35470200
20. Baumeister H, Seifferth H, Lin J, Nowoczin L, Lüking M, Ebert D. Impact of an Acceptance Facilitating Intervention on Patients' Acceptance of Internet-based Pain Interventions: A Randomized Controlled Trial. The Clinical journal of pain 2015;31(6):528-535. PMID:24866854
21. Lin J, Faust B, Ebert DD, Krämer L, Baumeister H. A Web-Based Acceptance-Facilitating Intervention for Identifying Patients' Acceptance, Uptake, and Adherence of Internet- and Mobile-Based Pain Interventions: Randomized Controlled Trial. J Med Internet Res 2018;20(8):e244. PMID:30131313
22. Healey BJ, Griffiths KM, Bennett K. The effect of programme testimonials on registrations for an online cognitive behaviour therapy intervention. DIGITAL HEALTH 2017;3:205520761772993. doi:10.1177/2055207617729937
23. Soucy JN, Owens VAM, Hadjistavropoulos HD, Dirkse DA, Dear BF. Educating patients about Internet-delivered cognitive behaviour therapy: Perceptions among treatment seekers and non-treatment seekers before and after viewing an educational video. Internet Interventions 2016;6:57-63. PMID:30135814
24. Ebert DD, Berking M, Cuijpers P, Lehr D, Pörtner M, Baumeister H. Increasing the acceptance of internet-based mental health interventions in primary care patients with depressive symptoms. A randomized controlled trial. Journal of affective disorders 2015;176:9-17. PMID:25682378
25. Apolinário-Hagen J, Fritsche L, Wopperer J, Wals F, Harrer M, Lehr D, Ebert DD, Salewski C. Investigating the Persuasive Effects of Testimonials on the Acceptance of Digital Stress Management Trainings Among University Students and Underlying Mechanisms: A Randomized Controlled Trial. Front. Psychol. 2021;12:738950. PMID:34721212
26. Reed Johnson F, Lancsar E, Marshall D, Kilambi V, Mühlbacher A, Regier DA, Bresnahan BW, Kanninen B, Bridges JFP. Constructing experimental designs for discrete-choice experiments: report of the ISPOR Conjoint Analysis Experimental Design Good Research Practices Task Force. Value Health 2013;16(1):3-13. PMID:23337210
27. Cunningham CE, Walker JR, Eastwood JD, Westra H, Rimas H, Chen Y, Marcus M, Swinson RP, Bracken K, The MMRG. Modeling mental health information preferences during the early adult years: a discrete choice conjoint experiment. Journal of health communication 2014;19(4):413-440. PMID:24266450
28. Phillips EA, Himmler SF, Schreyögg J. Preferences for e-Mental Health Interventions in Germany: A Discrete Choice Experiment. Value in Health 2021. doi:10.1016/j.jval.2020.09.018
29. Phillips EA, Himmler S, Schreyögg J. Preferences of psychotherapists for blended care in Germany: a discrete choice experiment. BMC Psychiatry 2022;22(1):112. PMID:35151294
30. Ann-Kathrin Schwientek. Formative qualitative research on the development of a discrete choice

experiment on e-Mental-Health information preferences and needs among prospect healthcare providers; 2021.
31. Braun P, Apolinário-Hagen J, Vomhof M, Stehl S, Icks A, Angerer P, Loerbroks A. Informing Future Healthcare Providers about eMental Health Services: A Discrete Choice Experiment on Preferences regarding Information Strategies among German-speaking Medical Students (preregistration): https://doi.org/10.17605/OSF.IO/2S9U8); 2022.
32. Bridges JFP, Hauber AB, Marshall D, Lloyd A, Prosser LA, Regier DA, Johnson FR, Mauskopf J. Conjoint analysis applications in health--a checklist: a report of the ISPOR Good Research Practices for Conjoint Analysis Task Force. Value Health 2011;14(4):403-413. PMID:21669364
33. Hollin IL, Craig BM, Coast J, Beusterien K, Vass C, DiSantostefano R, Peay H. Reporting Formative Qualitative Research to Support the Development of Quantitative Preference Study Protocols and Corresponding Survey Instruments: Guidelines for Authors and Reviewers. The Patient - Patient-Centered Outcomes Research 2020;13(1):121-136. PMID:31840215
34. Mayring P. Qualitative Inhaltsanalyse: Grundlagen und Techniken. Neuausgabe. s.l.: Beltz Verlagsgruppe; 2010. ISBN:9783407255334.
35. Braun P, Schwientek A-K, Angerer P, Guthardt L, Icks A, Loerbroks A, Apolinário-Hagen J. Investigating information needs and preferences regarding digital mental health services among medical and psychology students in Germany: A qualitative study. DIGITAL HEALTH 2023;9:20552076231173568. doi:10.1177/20552076231173568
36. Dederichs M, Weber J, Pischke CR, Angerer P, Apolinário-Hagen J. Exploring medical students' views on digital mental health interventions: A qualitative study. Internet Interventions 2021;25:100398. doi:10.1016/j.invent.2021.100398
37. Dederichs M, Nitsch FJ, Apolinário-Hagen J. Piloting an Innovative Concept of e-Mental Health and mHealth Workshops With Medical Students Using a Participatory Co-design Approach and App Prototyping: Case Study. JMIR Medical Education 2022;8(1):e32017. PMID:35006085
38. Wolcott MD, Lobczowski NG. Using cognitive interviews and think-aloud protocols to understand thought processes. Curr Pharm Teach Learn 2021;13(2):181-188. PMID:33454077
39. Collins LM, Dziak JJ, Li R. Design of experiments with multiple independent variables: a resource management perspective on complete and reduced factorial designs. Psychol Methods 2009;14(3):202-224. PMID:19719358
40. Kuhlfeld WF. Marketing Research Methods in SAS Experimental Design, Choice, Conjoint, and Graphical Techniques 2010 URL: http://support.sas.com/techsup/technote/mr2010.pdf [accessed 2023-08-27].
41. Bech M, Gyrd-Hansen D. Effects coding in discrete choice experiments. Health Econ 2005;14(10):1079-1083. PMID:15852455
42. Dutheil F, Pereira B, Moustafa F, Naughton G, Lesage F-X, Lambert C. At-risk and intervention thresholds of occupational stress using a visual analogue scale. PloS one 2017;12(6):e0178948. PMID:28586383
43. Johnson R, Orme B. Getting the Most from CBC 2003 URL: https://sawtoothsoftware.com/resources/technical-papers/getting-the-most-from-cbc [accessed 2023-08-27].
44. Mühlbacher A, Johnson FR. Choice Experiments to Quantify Preferences for Health and Healthcare: State of the Practice. Appl Health Econ Health Policy 2016;14(3):253-266. PMID:26992386
45. Swait J, Louviere J. The Role of the Scale Parameter in the Estimation and Comparison of Multinomial Logit Models. Journal of Marketing Research 1993;30(3):305-314. doi:10.1177/002224379303000303
46. Shorey S, Chan V, Rajendran P, Ang E. Learning styles, preferences and needs of generation Z healthcare students: Scoping review. Nurse Educ Pract 2021;57:103247. PMID:34768214
47. Hertling SF, Back DA, Eckhart N, Kaiser M, Graul I. How far has the digitization of medical teaching progressed in times of COVID-19? A multinational survey among medical students and

lecturers in German-speaking central Europe. BMC Med Educ 2022;22(1):387. PMID:35596161
48. Ogut E, Senol Y, Yildirim FB. Do learning styles affect study duration and academic success? Eur. J. Anat. 2017;21:235-240 URL: http://www.eurjanat.com/web/paper.php?id=170006eo.
49. Newton PM, Najabat-Lattif HF, Santiago G, Salvi A. The Learning Styles Neuromyth Is Still Thriving in Medical Education. Frontiers in Human Neuroscience 2021;15:708540. PMID:34456698
50. Bandura A. Social foundations of thought and action: A social cognitive theory. 7th print. Englewood Cliffs, N.J.: Prenctice Hall; ca. 1995. ISBN:013815614X.
51. Shaffer VA, Zikmund-Fisher BJ. Narratives in decision aids. In: Lucius-Hoene G, Holmberg C, Meyer T, editors. Illness narratives in practice. First edition: Oxford University Press; 2018. ISBN:9780198806660. p. 251–260.
52. Shaffer VA, Focella ES, Hathaway A, Scherer LD, Zikmund-Fisher BJ. On the Usefulness of Narratives: An Interdisciplinary Review and Theoretical Model. Annals of behavioral medicine : a publication of the Society of Behavioral Medicine 2018;52(5):429-442. PMID:29684135
53. Dederichs M, Weber J, Muth T, Angerer P, Loerbroks A. Students' perspectives on interventions to reduce stress in medical school: A qualitative study. PloS one 2020;15(10):e0240587. PMID:33057431
54. Groene OR, Huelmann T, Hampe W, Emami P. German Physicians and Medical Students Do Not Represent the Population They Serve. Healthcare (Basel) 2023;11(12). PMID:37372780
55. Apolinário-Hagen J, Harrer M, Dederichs M, Fritsche L, Wopperer J, Wals F, Loerbroks A, Lehr D, Salewski C, Angerer P, Ebert DD. Exploring the influence of testimonial source on attitudes towards e-mental health interventions among university students: Four-group randomized controlled trial. PloS one 2021;16(5):e0252012. PMID:34038455
56. Apolinário-Hagen J, Fritsche L, Wopperer J, Wals F, Harrer M, Lehr D, Ebert DD, Salewski C. Investigating the Persuasive Effects of Testimonials on the Acceptance of Digital Stress Management Trainings Among University Students and Underlying Mechanisms: A Randomized Controlled Trial. Front. Psychol. 2021;12:738950. PMID:34721212
57. Paganin G, Apolinário-Hagen J, SImbula S. Introducing mobile apps to promote the well-being of German and Italian university students. A cross-national application of the Technology Acceptance Model. Curr Psychol 2022:1-12. PMID:36320558
58. Aulenkamp J, Mikuteit M, Löffler T, Schmidt J. Overview of digital health teaching courses in medical education in Germany in 2020. GMS J Med Educ 2021;38(4):Doc80. PMID:34056069

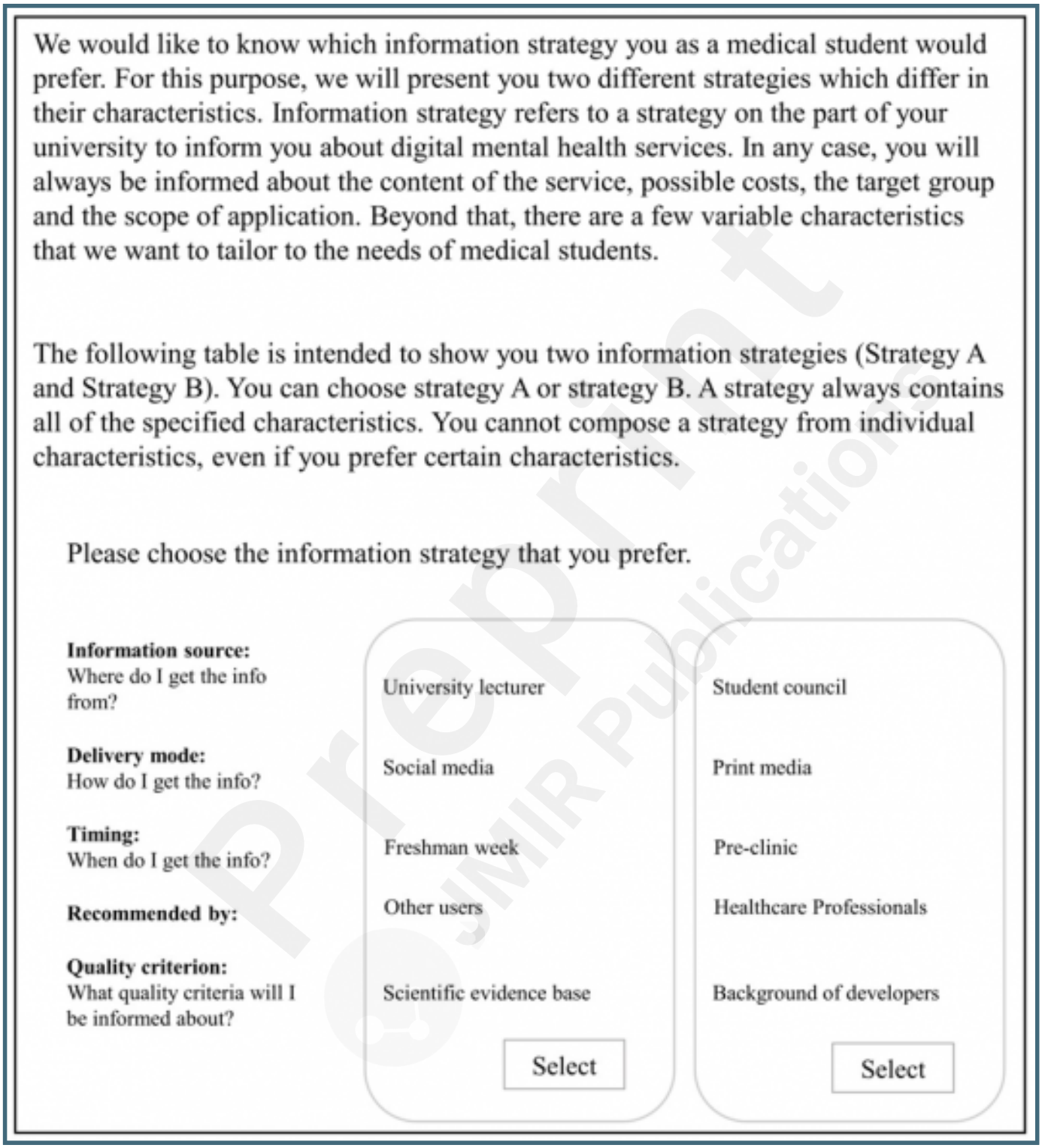
Abbreviations

AFIs: acceptance-facilitating interventions
BIC: Bayesian information criterion
BfARM: Federal Institute for Drugs and Medical Devices (German: Bundesinstitut für Arzneimittel und Medizinprodukte)
cAIC: consistent Akaike information criterion
CMDs: common mental disorders
DCE: discrete choice experiment
DMHI: digital mental health intervention
HCP: healthcare professionals
LCA: latent class analysis

Supplementary Files

Figures

Instruction and exemplary choice task.



Multimedia Appendixes

Choice making behavior – lexicographic scores.
URL: http://asset.jmir.pub/assets/bbec4a0f99ab7c99703f88e578ab577e.docx

Willingness to pay for digital mental health interventions (DMHIs).
URL: http://asset.jmir.pub/assets/c492e9b691738c891ce45150a1441a19.docx

Results of the complete sample analysis.
URL: http://asset.jmir.pub/assets/fd07d066dcc67f2eaff86a05249fdc93.docx

Further information on latent class analysis.
URL: http://asset.jmir.pub/assets/ee495b8316fe3e9b94e4b46e22befa2e.docx

CONSORT (or other) checklists

CONSORT-SPI-2018_Checklist.
URL: http://asset.jmir.pub/assets/9ca204062f387d938efde20fffd809d8.pdf