Acceptance of unsupervised app-based cognitive assessment in outpatient care

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Abstract

Background: The use of unsupervised, app-based cognitive assessments provides considerable opportunities for early and comprehensive testing for Alzheimer's disease, minimizing the demand on time and personnel resources in medical practices. However, the acceptance of such an app within healthcare has yet to be assessed.

Objective: In this pilot study, we examined the acceptance of an app-based, repeated cognitive assessment for early symptoms of Alzheimer's disease (neotivCare) in the outpatient care setting from both physicians' and patients' perspectives.

Methods: Fifteen primary care practices participated, where patients with self- or relative-reported memory problems could be prescribed an app for comprehensive cognitive testing. Patients used the app to test their episodic memory function weekly for three months at home. After the testing period and the final consultation, physicians and patients received questionnaires to assess the app's acceptance.

Results: We received completed questionnaires from physicians for 45 patients. Additionally, we received 45 completed questionnaires from the patients themselves. The physicians reported that, for most patients, the app supported their decision-making in the diagnostic process (58%). Additionally, most physicians found the app's information dependable (75%) and felt more certain in their decisions (84%). From the patients' perspective, a majority felt thoroughly tested (76%), and only a few considered the time commitment for the cognitive tests to be too burdensome (15%). Moreover, despite the weekly cognitive testing and the lengthy twelve-week testing period, a majority of patients participated in all tests (72%).

Conclusions: Our pilot study indicates a high acceptance of an app for unsupervised, app-based cognitive testing over an extended period from both the participating physicians' and patients' perspectives. These initial findings suggest that unsupervised app-based cognitive assessment can be integrated into healthcare. Clinical Trial: not applicable

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Conclusions: Our pilot study indicates a high acceptance of an app for unsupervised, app-based cognitive testing over an extended period from both the participating physicians' and patients' perspectives. These initial findings suggest that unsupervised app-based cognitive assessment can be integrated into healthcare.

Keywords: Mild cognitive impairment, Alzheimer's disease, cognition, computerized assessment, digital cognitive biomarkers, home-based assessment, smartphone-based assessment

Introduction

Timely diagnosis of Alzheimer's disease is a key objective, as interventions and novel pharmacological treatment approaches shift to the disease's early stages [1, 2]. It is the primary care physicians who often have the closest contact with their patients and who serve as the patient's initial contact point when they seek clarification for perceived changes in cognitive abilities. However, conventional neuropsychological screening tests lack sensitivity for early stages of Alzheimer's disease [3]. The drawback of more comprehensive cognitive test batteries is that these tests are time-consuming and that they need to be administered by specialized personnel, thus they are quite resource-intensive [4]. This makes it challenging to integrate early diagnosis into primary care and outpatient practices, impacting access, especially in rural areas where the nearest memory clinic is often more distant. Another disadvantage is the one-time testing in the setting of a medical practice, which has been shown to be influenced by daily variations (e.g., lack of sleep) [4, 5] and even the stereotype threat effect [6], reducing reliability and validity of the assessment.

A promising solution lies in mobile, app-based cognitive testing at home, which can save time and resources. Moreover, such apps offer the possibility for repeated testing, reducing the impact of daily variations and allowing for the assessment of symptom progression over time. In recent years, several mobile apps for cognitive testing for early Alzheimer's symptoms have been developed [4]. Among them is the neotivCare app (https://www.neotiv.com/en), which has been developed based on current insights into the functional anatomy of episodic memory [7-9]. The cognitive tests have already been assessed for their psychometric quality and feasibility in the general population and in a memory clinic sample [4, 10, 11]. For other unsupervised, mobile apps, feasibility and acceptance have been explored as well [12, 13].

What is currently lacking and of particular importance is testing the acceptance in the actual healthcare setting, for which this and other apps have been developed. In the present study, participating physicians in outpatient care had the opportunity to prescribe the neotivCare app to patients who consulted them for memory problems. After the patients had utilized the app for a duration of three months, and once the physicians had received and analyzed the test results, the physicians then evaluated the usefulness of the app in the diagnostic process, and the patients provided their feedback on their experience with the app-based testing. The objective of this study was to evaluate the acceptance of unsupervised app-based cognitive testing within the realm of care.

Methods

Study Procedure and Questionnaires

The project took place in collaboration between a major statutory health insurance in Germany (AOK Saxony-Anhalt), the physicians' network in a neighbourhood in the north-east of Germany (Magdeburg-Schönebeck) and neotiv GmbH. Before the commencement of the study, the study was first ethically reviewed through internal AOK procedures. The study was conducted between September 2021 and December 2022 in Magdeburg-Schönebeck. This period coincided with social distancing measures due to the SARS-CoV-2 pandemic.

Participating practices were recruited from the members of the physicians' network Magdeburg-Schönebeck. Patients consulting their physician for memory problems and who fulfilled further inclusion criteria were informed about the opportunity to test their cognition with the neotivCare app for three months. Inclusion criteria were self- or relative-reported memory problems persisting for at least six months and perceived as progressive, as well as owning a smartphone and being able to use it. Additionally, patients had to be insured with a specific major statutory health insurance in Germany (AOK Saxony-Anhalt). The exclusion criterion was a clear indication of dementia, as it requires timely optimal care. In addition to being informed by the physician, the patients received a

patient information sheet in which they were informed about the project. Patients provided informed consent through a participation declaration before starting the tests and then received information and an activation code to install and use the app. The testing period spanned three months with weekly assessments. An automated report was generated from the test results and made available to the treating physician.
After the physician and patient had discussed the results, both the physician and the patient received a short questionnaire. The physician answered, for each patient individually, to what extent the test results from the app had 1) supported decision-making in the diagnostic process, how they assessed the 2) dependability of the app information for deciding on the further diagnostic process, and 3) how certain they were, based on the app information, in having made the correct decision about the subsequent process.
Patients completed a questionnaire providing socio-demographic information (age, sex, educational attainment). Additionally, they answered to what extent they felt 1) their cognitive abilities were thoroughly assessed through the app-based assessment and to what extent they felt 2) the assessments were too time-consuming for them. All questionnaires were anonymous. Due to data protection reasons, linkage between the questionnaires, with medical records or with the results from the neotivCare app was not possible.

Sample

Medical practices. In total, 15 outpatient medical practices specializing in general medicine, internal medicine or neurology participated in the study. Physicians provided anonymized questionnaire responses on their acceptance of the app in the diagnostic process for 45 patients.
Patients. A total of 54 patients were included in the study. Of these, 45 individuals completed a questionnaire on sociodemographic factors and app usage. The average age was 66 years (standard deviation: 7, age range from 52 to 80 years), 56% were female. Most had completed ten years (“Realschulabschluss”, 51%), followed by nine years of schooling (“Hauptschulabschluss”, 22%), a university degree (13%) and thirteen years of schooling (“Abitur”, 7%), 2% had no formal education, and the remaining two participants did not provide information on their education (4%).

The neotivCare App

The cognitive testing using the neotivCare app was conducted remotely, without supervision, and in a home setting. The patients used their own mobile phone or tablet. The tests were administered weekly over a period of twelve weeks. A total of three different tasks were presented to assess episodic memory function. Each task was presented four times, resulting in the repetition of each specific task every three weeks.
The first task assessed memory precision for objects and spaces. Study participants had to initially memorize pictures and later decide whether the presented images were new or familiar. The second task evaluated memory for the spatial relationship of objects and scenes. Participants had to memorize objects and their positions in space. Subsequently, they had to select the previously shown object from a set of options and place it in the correct position in an empty space (see *Figure 1* for an illustration). The third task focused on scene recognition. Initially, patients were shown photographic images and asked to determine whether they depicted indoor or outdoor scenes. After 60-70 minutes, images were presented again, and patients had to decide whether they were new or familiar, they were also asked to rate their confidence in their judgment.

Figure 1. Example of one of the memory tasks. Used with permission from neotiv GmbH.

Statistical Analysis

The processing and analysis of the data were outsourced as an external contract and conducted by an independent research group. The analysis of responses to the items was done descriptively (relative frequencies).

Results

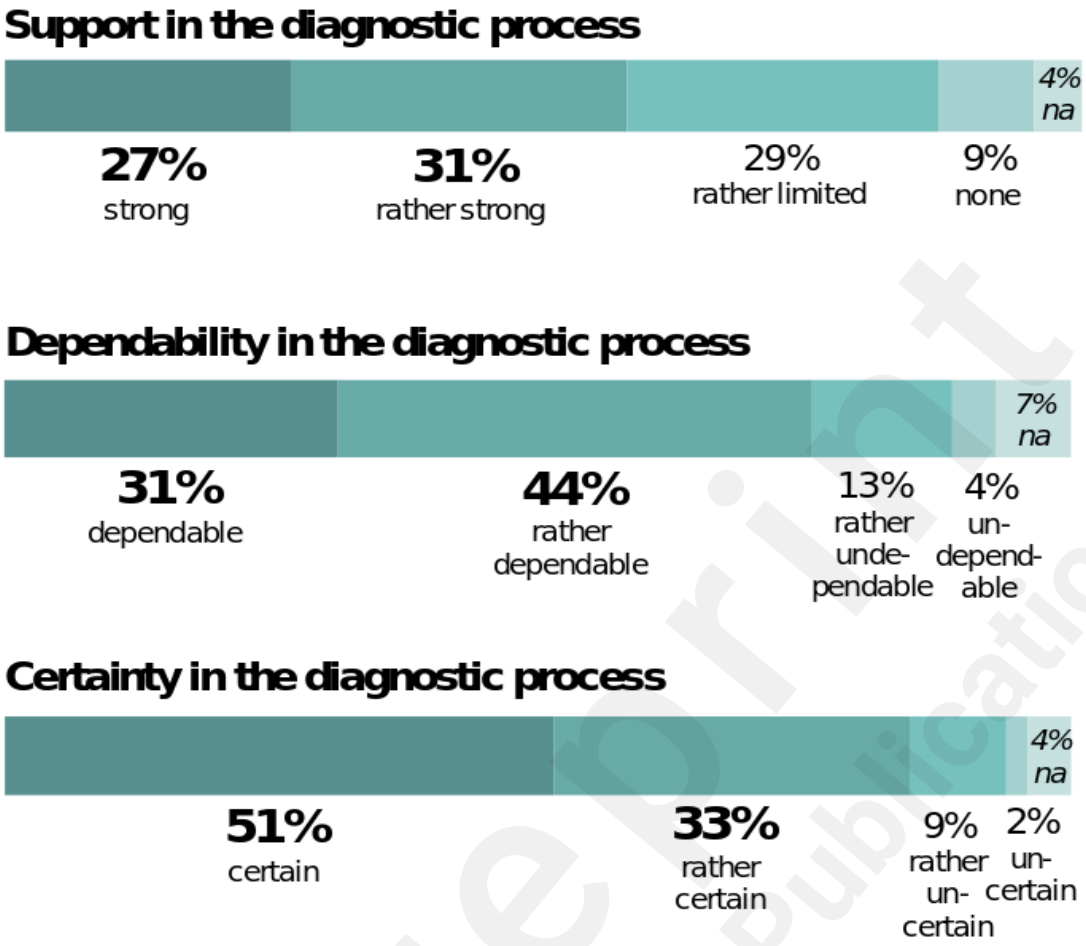
Acceptance among outpatient physicians

Figure 2 shows the distribution of responses from the participating physicians. For the majority of patients, the physicians indicated that the information from the app supported their decision-making in the diagnostic process (strongly [27%] or rather strongly [31%]), with only a few cases where the app was perceived by physicians as not supporting the diagnostic process at all (9%).

For a clear majority of patients, the physicians assessed the app information as dependable for making decisions about the further diagnostic process (dependable [31%] or rather dependable [44%]), with only a few patients where the app was considered somewhat (13%) or not dependable at all (4%).

In the clear majority of cases, the treating physicians reported feeling certain (51%) or rather certain (33%) in having made the correct decision for the further diagnostic process based on the app information. Only in a small number of cases did the physicians indicate that they were somewhat uncertain (9%) or uncertain (2%).

Figure 2. Distribution of responses from the physicians concerning acceptance of app-based cognitive testing for the diagnostic process.



Note. Data basis: questionnaires from the 15 participating practices regarding 45 patients.

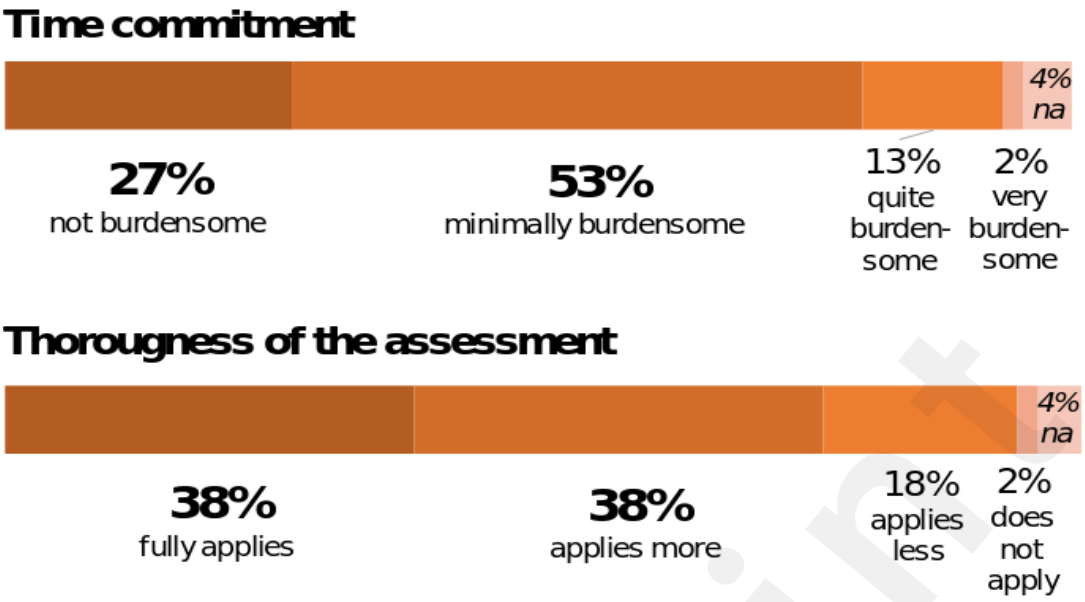
Acceptance among patients

Figure 3 shows the distribution of responses from the participating patients. Of the patients who had started participating in the study, 72% (39 out of 54) completed all weekly tests over twelve weeks, indicating high adherence throughout the study period.

When asked about the extent to which using the app was time-consuming, a clear majority responded that they felt either not at all (27%) or only slightly (53%) time-burdened by using the app. Feeling quite or very burdened was reported by 13% and 2% of the patients.

A large majority of patients stated that they felt thoroughly examined through the app: 38% agreed or somewhat agreed (38%). Slightly more than one-fifth disagreed to some extent (19%) or completely (2%).

Figure 3. Distribution of responses from the patients concerning acceptance of app-based cognitive testing.



Note. Data basis: responses from 45 of the 54 included patients.

Discussion

Unsupervised, app-based cognitive assessment offers significant opportunities to implement early and comprehensive testing for Alzheimer's disease, without placing a high burden on time and personnel resources in medical practices. However, the acceptance of such an app within the realm of care has not been tested thus far. In the present study, we examined the acceptance of an app-based, repeated cognitive assessment for early symptoms of Alzheimer's disease in the outpatient care setting.

Acceptance of the app from the perspective of the outpatient care physicians was assessed regarding its utilization in the diagnostic process. The physicians indicated that, for most patients, the app supported them in making decisions about the diagnostic process. Moreover, they indicated that they perceived the app information as dependable and that they felt more certain in their decisions. These initial findings suggest that participating physicians have shown acceptance toward the app for evaluating cognitive performance and were using the results to inform their next steps. This is promising, as acceptance from outpatient care physicians is crucial for enhancing early testing for Alzheimer's disease, as they often serve as the first point of contact for individuals experiencing memory problems.

The participating patients also gave largely positive feedback on the app: a majority felt thoroughly tested, and only a few considered the time commitment for the cognitive tests as too burdensome. Moreover, despite weekly cognitive testing and the lengthy testing period of twelve weeks, a large majority of patients participated in all tests. These initial results indicate a high level of acceptance and adherence from the patients. This is an important finding for the implementation of app-based cognitive assessment into routine healthcare, given that it is ultimately the patients who need to integrate the tests into their daily lives and perform them without supervision over an extended time period. Overall, these initial results regarding the acceptance of unsupervised app-based cognitive testing within the realm of care are promising. The next step should involve testing on a larger scale and investigating potential effects on healthcare delivery.

Limitations

To ensure data protection, it was not possible to link the physicians' and patients' questionnaires with

each other, nor was it possible to link them with results from the app or additional patient data. The results presented here are solely derived from the returned questionnaires, which were anonymized and provided to participating physicians and patients. The overall sample size was relatively small, and the inclusion criteria of the study may have introduced a potential selection bias in the recruitment process. For example, only patients who owned and could use a smartphone or tablet were included. However, currently, 80% of people aged 55 to 65 already own a smartphone, and this number is expected to rise in the future [14]. Furthermore, only patients insured with a specific major public health insurance (AOK Saxony-Anhalt) were eligible to participate. However, as the largest statutory health insurance in Saxony-Anhalt it covers a cross-section of the population.

Conclusion

After studies on the validity and feasibility of an app for unsupervised, app-based cognitive testing over an extended period [10, 11], this study also indicates a high level of acceptance among both physicians and patients in the outpatient care setting. These initial findings suggest that unsupervised app-based cognitive assessment can be integrated into health care. As a next step, the implementation of digital, app-based cognitive testing within the health care setting should be tested on a larger scale.

End-Matter

Acknowledgments

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Author's Contributions

IB, RT, MB, NL and PS designed the current study. IB and MB analyzed the data. IB, MB and RT interpreted the data. IB wrote the manuscript. All authors critically reviewed the manuscript, provided feedback, and approved it for submission.

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Conflicts of Interest Statement

IB, MB and RT declare no conflicts of interest. NL and PS are employees of neotiv GmbH – they were involved in conducting the study including data collection, but did not influence preparation, analysis and interpretation of data, which was carried out by IB, MB, and RT.

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