Validation of the Adapted German Versions of the Dementia Knowledge Assessment Tool 2, the Dementia Attitude Scale, and the Confidence in Dementia Scale for the General Population

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Abstract.
Background: There are almost no validated tools in German that assess dementia knowledge, attitude toward dementia, and confidence in the general population.
Objective: Translation and validation of the German version of the Dementia Knowledge Assessment Tool 2 (DKAT2), the Dementia Attitude Scale (DAS), and the Confidence in Dementia Scale (CODE).
Methods: Instruments were translated into German and adapted for the general public. A convenience sample of 263 persons was recruited via an online platform. Validation of the tools' psychometric properties consisted of an assessment of its reliability (internal consistency and 4-week test-retest reliability of a subgroup with $n = 110$), an analysis of its construct validity through principal component analysis and known-group analysis, convergent validity, and an item analysis for DKAT2-D. This study used the STROBE checklist for reporting.
Results: Acceptable to excellent internal reliability was found for DAS-D ($\alpha = 0.90$), DKAT2-D ($\alpha = 0.78$), and CODE-D ($\alpha = 0.93$). The principal component analysis confirmed the two-factor model for the DAS-D as well as the one-factor solution for CODE-D. The intra-class correlation coefficient between the first and the 4-week retest was good (CODE-D: 0.897; 0.849–0.929) to excellent (DKAT2-D: 0.918; 0.879–0.945 and DAS-D: 0.940; 0.910–0.960). Known-group analysis revealed that DAS-D, DKAT-D, and CODE-D could distinguish between individuals with or without experience with people with dementia and with or without participation in a dementia course.
Conclusion: The German versions DAS-D, DKAT2-D, and CODE-D are reliable and valid tools to measure knowledge, attitude, and confidence in dementia in the German-speaking general population.

Keywords: Attitude, dementia, knowledge, psychometrics, reliability, self-efficacy, validity

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INTRODUCTION

The life expectancy of a newborn child has risen continuously in Germany almost since records began in 1871 [1]. In the first half of the 20th century, the

enormous gains in life years were due to the decline in infant and child mortality and the successes in combating infectious diseases. Since the 1970s, the additional life years have been gained mainly at the age of 60 and above [2]. Since advanced age is the greatest risk factor for dementia [3], the number of people with dementia (PwD) and their caregivers has also increased dramatically in recent years. According to epidemiological estimates, about 1.6 million people in Germany lived with dementia in 2018. By 2050, it is estimated to be 2.4 to 2.8 million if no effective prevention or therapy measures are found [4]. Thus, dementia is presumed to be a major health problem [5].

Since dementia is a cognitive impairment syndrome that affects memory, cognitive ability, and behaviors, it significantly limits performing activities of daily living [6]. Most PwD in Germany are cared for at home by relatives, with most of them being female (73.6%) and with a mean age of 62.1 [7]. Because dementia is associated with functional dependency, the symptoms affect the quality of life of both the patient and informal carer [8], which is why the family caregiver is often referred to as the "invisible patient" [9]. Lack of knowledge and confidence in dementia care contributes to the negative attitude toward dementia seen in the general population, as the attitude consists of the three components: affect, behavior, and cognition [10]. Although people with dementia and their families are fundamentally affected by attitudes toward dementia, few studies exist regarding the general population's attitudes toward dementia [11]. Enhanced knowledge about dementia could help informal carers to cope better with behavioral and psychological symptoms of dementia (BPSD) and hence help to reduce the mental and physical burden on the caregiver [12, 13], which has a positive impact on the life quality of both the family caregiver and the PwD. This, in turn, impacts the stay at home for PwD since it is known that BPSDs are also associated with increased rates of placement in residential care [14].

Instruments measuring attitude, knowledge, and confidence in dementia care that are translated and validated into German are missing. Although Peng et al. (2011) translated and validated the Dementia Attitude Scale (DAS) [15] into German, it has been shown in practice that the German version is applicable to hospital staff but not to the general population; this is why an adaptation and validation for the general population seems necessary. Apart from that, the publication is only available in German,

which is why it is not mentioned in the international literature.

A number of questionnaires have been developed to measure knowledge about dementia with a different focus on prevalence, symptoms, treatment, and cure [16]. However, most are only available in English and are designed to measure knowledge of general practitioners or other healthcare professionals, but not of the general population [17]. The only available instrument in German, KIDE [18], is not validated yet. DKAT2 [19] evaluates the overall knowledge of dementia and dementia care and was also validated for family carers, focusing on the late stages of dementia. It has already been translated into Greek [20], Spanish [21], and Brazilian Portuguese [22], with the first two having also been validated. Its internal consistency is acceptable to good (0.68–0.83) in all languages available, and it addresses both family caregivers as well as staff carers. The tool therefore seems appropriate for use in the general population.

Since DAS mainly measures the cognitive and affective components of attitude, the Confidence in Dementia Scale (CODE) is a suitable instrument to complementarily measure the behavioral component, respectively self-efficacy. Until now, it is only available in English and Greek with an excellent internal consistency.

The aim of the cross-sectional study was to examine the psychometric properties of the German version of DAS, DKAT2, and CODE in the general population for further usage in research and evaluations of psycho-educational programs for informal carers and awareness programs for the general population.

MATERIALS AND METHODS

Design

A cross-sectional survey was conducted to evaluate the psychometric properties of the three translated instruments. The present study adheres to EQATOR guidelines for reporting research using the "Strengthening the Reporting of Observational Studies in Epidemiology" (STROBE) checklist [23] (Supplementary Material 1).

Participants

A convenient sample was recruited by means of newsletters, posters, and distribution of flyers, as well as by forwarding the call to participate in the study

via social channels such as Facebook and WhatsApp between July and October 2021. The only inclusion criterion was age over 18 years. The sample size estimation was guided by a rule of thumb with at least ten people per item [24]. Considering that DKAT2 was the most extended questionnaire with 21 items, a sample size of 210 (21*10) was required. Our final sample size was N = 263. A smaller sub-sample ($n = 110$) completed the instruments twice over a four-week interval (test-retest).

Data collection procedure

This study collected data via *Questionstar*, an online survey questionnaire tool. A structured questionnaire was prepared, including sociodemographic data (age, gender, education level), prior experience with PwD, the 21 items of DKAT2, the 20 items of DAS, and the 9 items of CODE. Those participants who agreed to participate a second time after four weeks to test the test-retest reliability were asked to provide their email address to receive an invitation and reminder via email for the second participation. Participants took about 5–30 min to complete the questionnaire.

Instruments

Dementia Attitude Scale (DAS): A 20-item questionnaire

DAS was developed to measure attitude toward dementia, and the original version was validated with college students and direct care workers but not with informal caregivers [15]. The instrument consists of 20 items on a seven-point Likert scale with responses ranging from 1 (strongly disagree) to 7 (strongly agree). It reflects the affective, behavioral, and cognitive components of the attitude toward dementia. The total scores achievable for this scale range from 20 to 140, with a higher score indicating a more positive attitude. Six items were reverse-scored (2, 6, 8, 9, 16, 17). DAS has a two-factor structure with high total internal consistency reliability (Cronbach's alpha coefficient ranged from 0.83–0.85) and a first factor ($\alpha = 0.82$) covering "dementia knowledge" (items 3, 7, 10, 11, 12, 14, 15, 18, 19, and 20) and a second factor ($\alpha = 0.75$) covering "social comfort" (items 1, 2, 4, 5, 6, 8, 9, 13, 16, and 17). The two factors explain 38.72% of the total variance and are correlated ($r = 0.29$, $p < 0.01$). Knowing someone with dementia was associated with a more positive attitude.

Dementia Knowledge Assessment Tool 2 (DKAT2): A 21-item questionnaire

The DKAT2 was developed to provide a reliable, valid, and feasible tool to evaluate foundation-level knowledge of dementia [19]. The tool was piloted with family carers, aged care workers, and nurses who provided support for residents with dementia. DKAT2 is a unidimensional questionnaire with 21 items addressing different areas of dementia knowledge, encompassing features of Alzheimer's disease and vascular dementia, behavioral, emotional, physiological, functional, and sensory symptoms of dementia, as well as symptoms that are not necessarily associated with dementia. The instrument helps to evaluate knowledge of all dementia-related illnesses and dementia care, making it broadly applicable. DKAT2 has a promising internal consistency reliability (Cronbach's alpha coefficient was 0.79). There are three possible answers for each statement: "yes", "no", and "don't know". Answers are scored as 1 if correct and 0 if incorrect or "don't know". Thirteen items are correct statements, and eight are incorrect (5, 6, 7, 8, 12, 16, 18, 20), which were reverse-scored. The higher the final score, the higher the knowledge about dementia.

Confidence in Dementia (CODE) Scale: A 9-item questionnaire

This nine-item self-report questionnaire is a unidimensional questionnaire that measures confidence in working with people with dementia [18] and has an excellent internal consistency reliability (Cronbach's alpha coefficient: 0.91). It is scored on a five-point Likert scale with anchored ratings of "not confident", "somewhat confident", and "very confident". The total scores achievable for this scale range from 9 to 45, with a higher score representing better confidence in caring for people with dementia. Cut-off points within the scale are as follows: 0–18 not confident, 19–35 somewhat confident, 36–45 very confident.

Developing the German version of the questionnaires

The translation-back translation method was used to translate the English version of the DKAT2, the DAS, and the CODE into German [25]. In detail, two German experts in dementia studies translated the original English version separately into German. The research team reviewed the different translations to resolve differences and ensure cultural adaptation, producing a single version (synthesis) from

both translations. This first German version was back-translated by a bilingual public health expert whose mother language was English. The original English version and the back-translated versions were compared for consistency, relevance, and meaning of the content. Some items which showed that the original questionnaire was developed for care professionals (e.g., it is rewarding to work with people with dementia) were adapted for the general population by replacing the verb "work" with "interact". Furthermore, the expression "ADRD" (Alzheimer's disease and related dementias) in DAS was replaced by "dementia" because the participants had some difficulties understanding this expression. The scales were administered to ten people to examine the adaptation of the changed items before finalizing the German version of the questionnaires (Supplementary Material 2).

Statistical analysis

The statistical analysis was carried out using SPSS V27.0. The following psychometric properties were evaluated: internal consistency and test-retest reliability after a 4-week interval, structural validity through principal component analysis and known-group analysis, convergent validity, as well as item analysis for DKAT2-D.

The **internal consistency** reflects the estimation of homogeneity across scale items. The interconnection of items is measured with Cronbach's alpha coefficient, ranging from 0 to 1, with a value between 0.70 and 0.95 indicating a high level of internal consistency and values above 0.95 indicating a redundancy of items [26]. The **test-retest reliability** tests the stability of the tool over time. For this purpose, all of the participants were asked to complete the questionnaire a second time after an interval of 4 weeks. The intra-class coefficient correlation (ICC) was used to test the reliability between the total score of the first and second completion [27]. An ICC greater than 0.7 was considered indicative of a good correlation and an ICC greater than 0.9 an excellent correlation [26, 28].

The **structural validity**, defined as the degree to which scores of a questionnaire are an adequate reflection of the dimensionality of the construct to be measured [29], was investigated by means of exploratory factor analysis. A Principal Component Analysis (PCA) with varimax rotation was used to extract factors. It was tested whether the same factor structure was maintained as in the original English version. Also, to test whether the variables were suitable for PCA, the Kaiser-Meyer-Olkin (KMO) value was calculated for sample size adequacy with a minimum acceptable value of 0.5. Furthermore, Bartlett's test of sphericity was calculated to determine the suitability of the scale items for analysis, where Bartlett's spherical value should be significant with a *p*-value less than 0.05. To reconstruct a lower-dimensional dataset that still includes adequate sources of variance, we applied the Guttman-Kaiser eigenvalue-greater-than-one rule and confirmed the results using a scree plot [30].

Construct validity was tested through the known-group method (groups with expected high and low knowledge and confidence in dementia care and a more or less positive attitude toward dementia). In addition, the following two hypotheses were tested by Student's *T*-Test with all three translated tools: 1) professionals with experience with PwD will achieve higher scores than people without any professional experience 2) participants with personal contact with PwD will achieve higher scores than people without personal contact with PwD.

An **item analysis** was conducted for DKAT2-D, both for the total sample and separately for those who did and did not participate in a dementia course, whereas difficulty, ignorance, and indices were estimated for each item [31]. According to the percentage of correct answers (difficulty index), items were classified into six categories: very easy (<90%), easy (75.1%–90%), somewhat easy (50.1%–75%), somewhat difficult (25.1%–50%), difficult (10.1%–25%), and very difficult (<10%). The ignorance percentage shows the percentage of "I don't know" answers.

Because the online tool was programmed to move to the next question only when the previous question was answered, there was no missing data.

Ethics

The study protocol was approved by the Ethics Committee of the Faculty of Behavioral and Cultural Studies of Heidelberg University, Germany (AZ Tei 2021 1/1). All procedures contributing to this work comply with the ethical standards outlined in the Declaration of Helsinki, which is relevant to the national and institutional committees on human experimentation. All participants participated voluntarily in the study. They were informed about the procedure and the aim of the study and subsequently gave their permission for participation via an informed consent option in the online questionnaire.

Table 1
Participants' characteristics of the total and the sub-sample

Characteristics	Total sample (N = 263)		Sub-sample[1] (n = 110)	
	n	%	n	%
Age				
Mean	45.58		49.92	
SD	17.54		17.86	
Gender				
Male	62	23.6%	26	23.6%
Female	201	76.4%	84	76.4%
Education				
9 y	3	1.1%	0	
10 y	18	6.8%	6	5.5%
12-13 y	56	21.3%	16	14.5%
Vocational training	43	16.3%	14	12.7%
Bachelor	28	10.6%	8	7.3%
Master/Diploma	102	38.8%	45	40.9%
PhD	41	15.6%	19	17.3%
Others	7	2.7%	7	6.5%
Occupation				
School student	3	1.1%	2	1.8%
Student	51	19.4%	17	15.5%
Unemployed	6	2.3%	2	1.8%
Retiree	32	12.2%	23	20.9%
Care profession	23	8.7%	8	7.3%
Therapeutical profession	29	11.0%	11	10.0%
Physician	9	3.4%	3	2.7%
Others	128	48.7%	51	46.4%
Experience with PwD				
I know one or more persons with dementia	161	61.2%	70	63.6%
I care for a person with dementia	14	5.3%	4	3.6%
I work with PwD	60	22.8%	23	20.9%
Relationship to the person with dementia e.g., partner, grandparent, parent	96	36.5%	40	36.4%
No experience with PwD	34	12.9%	14	12.8%
Participation in a program about dementia				
Yes, I participated	97	36.9%	44	40.0%
One time	44	16.7%	18	16.4%
2–4 times	25	9.5%	12	10.9%
More than 5 times	28	10.6%	13	11.8%
I did not participate	166	63.1%	66	60%

[1]sub-sample after four-weeks for test-retest.

RESULTS

Participants' characteristics

The complete data from 263 participants of the general population were used for the analysis of the psychometric properties. In addition, a sub-sample of 110 participants completed the questionnaire a second time after a period of four weeks. To summarize, main characteristics of the complete study population were as follows: the average age was 45.6 years, most participants were female (76.4%), had at least a master's degree (54.4%), 12.9 % did not know at least one person with dementia, while the most participants have never participated in a course or seminar on dementia (63.1%) (Table 1). The mean score for

the DAS-D was 103.69 (105.28), for DKAT2-D 14.84 (15.37), and for CODE-D 24.87 (24.47).

DAS-D

Construct validity and reliability

Despite the clear two-factor solution proposed by O'Connor and McFadden, an exploratory factor analysis (EFA) was conducted to define the structural validity. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was found to be 0.907, while Bartlett's sphericity test was found to be significant, $\chi^2(190) = 1928.66$, $p < 0.001$. This shows that the requirements for a factor analysis are fulfilled because the sample consists of related variables. Also, the PCA with varimax rotation, where all

Table 2
Exploratory factor analysis of the Dementia Attitude Scale (DAS-D) with two factors

Nr.	Item	Mean (SD)	Cronbach's α if item deleted	Factor 1 "social comfort"	Factor 2 "know-ledge"	h^2
02.*	I am afraid of people with dementia.	5.61 (1.38)	0.89	**0.74**		*0.55*
09.*	I would avoid an agitated person with dementia.	4.94 (1.43)	0.89	**0.71**		*0.57*
05.	I am comfortable touching people with dementia.	4.70 (1.43)	0.89	**0.68**		*0.52*
06.*	I feel uncomfortable being around people with dementia.	5.14 (1.51)	0.89	**0.66**		*0.48*
13.	I feel relaxed around people with dementia.	4.11 (1.40)	0.89	**0.66**		*0.52*
16.*	I feel frustrated because I do not know how to help people with dementia.	4.14 (1.72)	0.89	**0.63**		*0.41*
04.	I feel confident around people with dementia.	3.82 (1.33)	0.89	**0.61**		*0.44*
08.*	I am not familiar with dementia.	4.02 (1.95)	0.90	**0.61**		*0.37*
17.*	I cannot imagine caring for someone with dementia.	4.98 (1.65)	0.89	**0.56**		*0.37*
01.	It is rewarding to interact with people with dementia.	4.88 (1.39)	0.89	**0.51**	0.49	*0.49*
19.	We can do a lot now to improve the lives of people with dementia.	5.95 (1.04)	0.89		**0.70**	*0.51*
12.	It is possible to enjoy interacting with people with dementia.	5.49 (1.30)	0.89		**0.68**	*0.57*
15.	People with dementia can feel when others are kind to them.	6.16 (0.86)	0.89		**0.68**	*0.54*
03.	People with dementia can be creative.	5.38 (1.29)	0.89		**0.63**	*0.46*
11.	It is important to know the past history of people with dementia.	5.96 (1.10)	0.89		**0.62**	*0.39*
20.	Difficult behaviors may be a form of communication for people with dementia.	5.48 (1.18)	0.89		**0.62**	*0.43*
10.	People with dementia like having familiar things nearby.	6.25 (0.97)	0.89		**0.61**	*0.39*
14.	People with dementia can enjoy life.	5.28 (1.33)	0.89		**0.61**	*0.42*
07.	Every person with dementia has different needs.	6.38 (0.86)	0.89		**0.53**	*0.29*
18.	I admire the coping skills of people with dementia.	5.10 (1.27)	0.90		**0.40**	*0.20*
	Eigenvalue λ of the rotated factors			4.52	4.42	
	Total variance explained			**22.59%**	**22.10%**	**Σ 44.69%**

*Reverse-scored items.

scale items were evaluated together, was conducted. When the eigenvalue was set to a minimum of 1 and the criterion for factor loading was set at ≥ 0.30, a three-factor solution was revealed with an explained variance of 50.69%, with 9 items loading on the first factor, 7 on the second, and 4 on the third. Due to the lack of a clear structural form in which six items loaded on two factors and considering Cattell's criterion, which confirmed the two-factor-solution, an EFA with two factors was conducted, which explains 44.69% of the total variance. All items loaded significantly onto the respective factors "social comfort" and "knowledge" of the original English version with a factor loading ≥ 0.4. Only item 1, adapted in the German version due to the applica-

bility to the general public, loaded on both factors (Table 2).

The internal consistency of the 20-item scale was $\alpha = 0.90$ with both factors showing a high internal reliability (social comfort: $\alpha = 0.86$; knowledge: $\alpha = 0.84$). Besides, no item could increase the value of Cronbach's alpha when deleted (Table 2).

Known-group validity

As hypothesized, the T-Test demonstrated a significant difference in participants who have no experience with PwD (12.9%, $n = 34$) (mean = 94.35, SD 14.03) and those who at least know a person with dementia (mean = 105.08, SD 15.35) in the DAS-D scores, $t(45.57) = 3.84$, $p < 0.001$. Furthermore,

Table 3
Item analysis of the DKAT2-D

Items	Total sample (N = 263)		Participated in dementia course (n = 97)		Did not participate in a dementia course (n = 166)	
	Difficulty index %	Ignorance index %	Difficulty index %	Ignorance index %	Difficulty index %	Ignorance index %
1	95.8	3.4	99.0	0.0	94.0	5.4
2	96.2	2.3	97.9	1.0	95.2	3.0
3	39.9	22.1	54.6	6.2	31.3	31.3
4	56.7	38.0	83.5	14.4	41.0	51.8
5*	75.3	13.3	79.4	7.2	72.9	16.9
6*	85.9	7.6	89.7	4.1	83.7	9.6
7*	8.0	12.2	7.2	14.4	8.4	10.8
8*	67.7	30.0	83.5	15.5	58.4	38.6
9	60.1	16.0	66.0	14.4	56.6	16.9
10	85.2	10.6	88.7	8.2	83.1	12.0
11	89.7	9.1	99.0	1.0	84.3	13.9
12*	32.7	20.9	47.4	11.3	24.1	26.5
13	92.8	6.1	99.0	1.0	89.2	9.0
14	60.1	34.6	84.5	11.3	45.8	48.2
15	71.1	21.7	87.6	7.2	61.4	30.1
16*	74.1	19.0	85.6	11.3	67.5	23.5
17	75.7	19.0	89.7	6.2	67.5	26.5
18*	87.8	9.9	94.8	3.1	83.7	13.9
19	83.7	11.8	88.7	7.2	80.7	14.5
20*	58.2	35.7	70.1	20.6	51.2	44.6
21	87.8	11.8	95.9	4.1	83.1	16.3
Mean	70.7	16.9	80.6	8.1	64.9	22.1

*Reverse-scored items.

persons who participated in a dementia program (course, seminar or workshop) (36.9%, $n = 97$) showed a significant higher DAS-D (mean = 113.60, SD 13.94) than those who never participated in a program (mean = 97.90, SD 13.46), t(261) = 9.00, $p < 0.001$.

DKAT2-D

Internal consistency

Cronbach's alpha of DKAT2-D was 0.78. Deleting item 7 could increase the value of Cronbach's alpha to 0.79.

Known-group validity

When testing the known-group validity, the T-Test showed a significant difference in participants who have no experience with PwD (mean = 12.74, SD 3.71) and those who know at least a person with dementia (mean = 15.16, SD 3.50), t(261) = 3.73, $p < 0.001$ as well as between participants who already participated in a program about dementia (mean = 16.92, SD 2.70) and those who never participated in such a program (mean = 13.63, SD 3.54), t(243.36) = 7.89, $p < 0.001$.

Item analysis

Difficulty and ignorance indices were estimated for each item (Table 3), both for the total sample and according to the participation in a dementia program. For the total sample, three items were very easy, six items easy, eight items somewhat easy, two items somewhat difficult, one item very difficult, and 14 items received a correct response from at least 65% of participants. Overall, the sub-population of participants who participated in a program about dementia showed more correct answers with great differences in items 3, 4, 8, 12, and 14. The percentage of "I don't know" answers were in general lower than for those who never participated in a course about dementia.

CODE-D

Construct validity and reliability

Structural validity was investigated by means of exploratory analysis. Hence, a PCA with varimax rotation was conducted. The eigenvalue was specified to a minimum of 1, and the criterion for factor loading was set at ≥ 0.30. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was found to be 0.895, while Bartlett's sphericity test was found to be significant, $\chi^2(36) = 1941.72, p < 0.001$. CODE has been

Table 4
Test-Retest Reliability (*n* = 110)

	Intraclass Correlation Coefficient	95% - Confidence interval	
		Lower bound	*Upper bound*
DKAT2-D	0.918	0.879	0.945
DAS-D	0.940	0.910	0.960
Social Comfort	0.942	0.915	0.960
Dementia Knowledge	0.888	0.831	0.925
CODE-D	0.897	0.849	0.929

CODE-D, Confidence in Dementia Care; DAS-D, Dementia Attitude Scale; DKAT2-D, Dementia Knowledge Assessment Tool 2.

designed as a unidimensional scale, which has been confirmed by the exploratory factor analysis as well as by Cattell's criterion. The one factor explains 65.23% of the total variance (eigenvalue = 5.87). Mean scores, SD, and Cronbach's alpha value when one item was deleted are depicted in Table 4. The internal consistency was very satisfactory with Cronbach's alpha being $\alpha = 0.93$ for the total CODE-D scale with nine items.

Known-group validity

The T-Test showed a significant difference in participants who have no experience with PwD (mean = 17.53, SD 6.51) and those who know at least a person with dementia (mean = 25.96, SD 7.90), t(261) = 3.73, $p < 0.001$ as well as between participants who already participated in a program about dementia (mean = 28.98, SD 7.56) and those who never participated in such a program (mean = 22.47, SD 7.64), t(261) = 7.89, $p < 0.001$.

Test-retest reliability of all scales

A four-week test-retest reliability was evaluated in a sub-sample of $n = 110$ using an ICC. Based on the 95% confident interval of the ICC estimate, values between 0.75 and 0.9 and greater than 0.90 are indicative of good and excellent reliability, respectively [26]. As indicated in Table 4, all values were between 0.83 and 9.60, indicating the stability of the measure.

Correlations among questionnaires

The convergent validity of the questionnaires was tested. DAS-D has a strong positive relationship to DKAT2-D ($r = 0.523**$, $p < 0.001$) with a higher correlation of the DAS-D "knowledge" ($r = 0.505**$, $p < 0.001$) than of the DAS-D "social comfort" ($r = 0.441**$, $p < 0.001$). There is also a strong positive correlation of DAS-D to CODE-D ($r = 0.695**$,

$p < 0.001$) with a higher correlation of the subscale "social comfort" ($r = 0.718**$, $p < 0.001$) than of the subscale "knowledge" ($r = 0.486**$, $p < 0.001$). Additionally, CODE-D has a medium positive correlation to DKAT2-D ($r = 0.438**$, $p < 0.001$).

DISCUSSION

This cross-sectional study aimed to analyze the psychometric properties of the German version of DAS, DKAT2, and CODE in the general population. All three scales showed an acceptable (DKAT2-D) to high (DAS-D and CODE-D) internal reliability. Construct validity, tested by the known-group method, revealed that all three scales can differentiate correctly between people with or without prior experience with PwD and between people who did or did not follow a dementia program. DAS-D ("social comfort") was highly correlated with CODE-D and DAS-D ("knowledge") with DKAT2-D. The two-factor structure ("social comfort" and "knowledge") of DAS-D proposed by O'Connor and McFadden (2010) [15] could be replicated with all items loading on the same factor as in the original study. In accordance with the original scale, the one-factor structure of CODE [18] could be confirmed. All three scales showed a good to excellent test-retest reliability.

DAS-D has a high internal reliability (Cronbach's for the total scale $\alpha = 0.90$ with $\alpha = 0.86$ for social comfort and $\alpha = 0.84$ for knowledge), which is slightly higher than in the original version ($\alpha = 0.83$–0.85) and also as the German version published by Peng et al. [11]. As the article by Peng et al. (2011) is available only in German, it is not cited in the other validation studies. Since it was a project of the Swiss Alzheimer's Association, DAS was also translated into the other national languages Italian and French. In all three language versions, a satisfactory two-factor solution could be replicated, whereby, in each case, the factor social comfort (Cronbach's alpha German: 0.86, French: 0.83 and Italian: 0.86)

showed somewhat higher reliability coefficients than the factor knowledge (German: 0.70, Italian: 0.60, French: 0.70). This was also observed in the original version as well as in the current study. Besides the validation study of Peng et al. (2011), the DAS has also been translated and validated for use in Croatian (care workers and general population) [32], Greek (psychology students) [20], Dutch (general population) [33], and Turkish (students of the medical and health sciences faculty) [34]. All studies showed a high internal reliability with the only exception of the Greek version, which had an acceptable Cronbach's alpha for the total scale (0.74) and the subscale social comfort (0.72) but a relatively low reliability for the factor knowledge (0.67).

Regarding the factor structure, DAS-D clearly identified the two factors: social comfort and knowledge, with all items loaded on the same factors as in the original version. In contrast, in the study by Peng et al. (2011), two items loaded on different factors, as well as in the Greek study [20], where item one ("It is rewarding to work with people who have ADRD") is loading on the factor knowledge instead of social comfort. The Croatian [32] and Dutch [33] two-factor-solution showed a positive-negative structure, which means that all items with a positive valence loaded on one factor and all items with a negative one on the other factor. The Turkish version [34] revealed three factors, as the current study did in the exploratory analysis, called "Supportive Attitude", "Acceptive Attitude", and "Exclusionary Attitude" with great differences in our factor loading.

In accordance to other studies [35], the current study found a significant positive association between experience with PwD or participation in a program about dementia and attitude, knowledge, and confidence in dementia care. Similar results could be represented by Gkioka et al. (2020), where a positive association between the previous contact of students with PwD and attitude was demonstrated, while the studies by Çetİnkaya et al. [34] and de Veer [33] could not find any associations.

In summary, DAS-D, which was adapted to the general population, can be used to assess attitude in the general population due to its high reliability, the convergent validity evidence, but also due to its practical length and ease of administration [20]. So far, it is the only tool to assess attitude in German. Another tool such as AQD [36], a two-factor scale (hope and recognition of personhood), determines attitudes toward dementia on a 19-item scale but does not cover the entire construct of attitude [15] with

its three components: affect, behavior, and cognition [10].

DKAT2-D showed good psychometric properties for reliability and validity. The internal reliability (Cronbach's $\alpha = 0.78$) was comparable to the original version ($\alpha = 0.79$), which was validated with family carers and staff members. DKAT2 was also translated into Greek [20], Spanish [21], and Brazilian Portuguese [22], but only the Greek ($\alpha = 0.68$ for psychology students) and Spanish versions ($\alpha = 0.76$ for nursing professionals and 0.83 for nursing students) were validated. To our knowledge, there is no validated German version of a dementia knowledge questionnaire. For hospital staff, often the Knowledge in Dementia (KIDE) scale [18] is used, which is available in German but not validated yet [37]. In general, most of the dementia knowledge questionnaires are validated in health professionals, caregivers, or students, like the Alzheimer's disease knowledge test (ADKT) [38], the DK-20 [39], or the University of Alabama Alzheimer's Disease Knowledge Test (UAB-ADKT) [40]. However, only a few questionnaires, such as the Alzheimer's Disease Knowledge Scale (ADKS) [41] and the Dementia Knowledge Assessment Scale (DKAS) [42], have been validated in several groups including the general population. The ADKT seemed once suited to international use with its established psychometric properties, but some items are now outdated [43]. The dementia quiz (DQ) [44] is most suitable for caregivers and, like the UAB-ADKT, less often used in research [43], while the DKAT2 seems to be a useful tool in research [45] due to its ability to differentiate correctly between people with high and low knowledge. Due to the three response options ("Yes", "No", "I don't know"), the participants are not forced to choose between the Yes or No option, avoiding the bias of correct answers at random [46]. Besides, it was possible not only to assess the difficulty index but also the ignorance index (percentage of "I don't know" answers). The current study showed a mean score of 14.84 (SD 3.61) of correct answers in the total sample with a range of 0–21, with a mean score of 15.16 of those who know at least a person with dementia, and a mean score of 16.92 of those who participated in a program about dementia, which confirmed the hypothesis that the tool can discriminate between people of low and high knowledge. The overall knowledge (70.7% of correct answers) was smaller than in the study by Parra-Anguita et al. (2018) (72.9%–78.9%) [21], comparable to the correct answers shown by Piovezan et al. (2018) in family carers (70.5%) [22] and Robinson et al. [47]

in Australia among staff and family carers (76.1%) as well as in the original study by Toyes et al. (2014) (70.5%; 74.0% staff and 67.0% family carers) [19]. The current study showed more items that were very easy and easy than the study by Gkioka et al. [20], while the study by Parra-Anguita et al. [21] showed less very easy and easy items among the nursing students but more among the nursing home staff.

Important to mention is that item 7 ("Knowing the likely cause of dementia can help to predict its progression"), which seems to be complicated (only 8% correct answers), was answered correctly in the original version by Toye et al. (2014) by 68% [19] but reached only 10% correct answers from Gkioka et al. (2020). This item, which is, according to the original version, one of the incorrect statements, was classified as a correct answer both by Piovezan et al. [22] and Parra-Anguita et al. [21] without mentioning somewhere. The number of "I don't know" answers was higher for almost all items in those who did not participate in a dementia course, except for item 7. The same tendency can be seen by Parra-Anguita et al. [21], with a lower ignorance index in the nursing home staff than in nursing students.

Overall, the DKAT2-D has evidence of reliability and good evidence of validity. Furthermore, it seems to discriminate well between low and high knowledge in the general population and appears to be stable over time. Therefore, it supports the use for further research in the general population.

Our study confirmed the one-factor-solution for CODE-D and demonstrated very satisfactory psychometric properties, with a slightly higher internal reliability (Cronbach's $\alpha = 0.93$) in comparison to the original version ($\alpha = 0.91$ and $\alpha = 0.88$ in the second phase of the study) [18, 48], and to the Greek version ($\alpha = 0.85$) [20], which is the only available translation and validation of CODE into any other language. Validated tools to assess confidence in dementia care are scarce, although the present tool has comparable psychometric properties to other scales which assess self-efficacy and therefore can be adequately used in research [48, 49]. The tool is able to discriminate between confidence on a lower or higher level, as shown by T-Tests of persons who know at least one person with dementia and those with no experience with dementia, respectively people who did or did not participate in a dementia program. These results are comparable to the study by Elvish et al. [48], who identified a significant change between pre-post measures of a dementia care training program. Besides, CODE-D is stable over time and therefore demon- strates utility in the field of dementia research not only for health professionals but also for the general population.

Limitations and strength

Despite the fact that our sample has a great heterogeneity in age, occupation, and previous experience with dementia, and only 37% of our sample has already participated in a program on dementia, it cannot be excluded that the sample is not representative of the general population. Furthermore, the proportion of individuals with at least a master's degree is disproportionately large, which is why we can assume that our convenient sample is not representative for the German population. This was to be expected due to the recruitment, among others, via a newsletter of the Network Aging Research since mainly people who had an interest in the topic of aging were enrolled, even if further participants were recruited with a snowball system. In addition, the proportion of people working in a nursing or therapeutic professions was higher than expected in the general population. Convergent validity was tested only by correlating DAS-D (knowledge) with DKAT2-D and DAS-D (social comfort) with CODE-D and not by comparing the psychometric properties of similar scales, which was beyond the scope of the current study.

Further educational intervention studies with a larger sample and follow-up measurements should be conducted to evaluate the sensitivity of the questionnaires for detecting changes in attitude, knowledge, and confidence in dementia care.

Conclusions

DAS-D, DKAT2-D, and CODE-D are reliable and valid tools to assess dementia attitude, dementia knowledge, and confidence in dementia care in the German general population. However, further intervention studies are needed to confirm the sensitivity to discriminate changes after a psycho-educational program for informal carers or before and after programs like the worldwide "Dementia Friends" program which aims to raise awareness of dementia in the general population.

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SUPPLEMENTARY MATERIAL

The supplementary material is available in the electronic version of this article: https://dx.doi.org/10.3233/JAD-220678.

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