

# Medicinal Plants Used for Abdominal Discomfort – Information from Cancer Patients and Medical Students

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**Abstract.** *Background/Aim: Abdominal discomfort during tumour therapy often leads to the use of phytotherapeutics from the field of folk medicine. What knowledge base do patients and young physicians have when they come across this phenomenon together? Patients and Methods: We conducted an online survey of 157 medical students and, in consultation, 125 patients according to a standardised algorithm about their knowledge and use of a list of given medicinal plants for the above-mentioned symptomatology. We previously created the list of traditional German medicinal plants taking into account the symptoms of bloating, fullness, diarrhoea, constipation, and nausea. Both data pools are presented descriptively, compared using principal component analysis, and student knowledge was subjected to network analysis. Results: As a median, patients know 9 medicinal plants and use 4 species. Students know 10 medicinal plants and use 5 species. The rate of non-users is 13.6% among patients and 11.4% among students. The plants used by both groups are ginger and mint, whereas patients also use camomile and fennel. The nearly coincident knowledge profile speaks of a common knowledge base – folk medicine. Network analysis illustrated that students stored their knowledge in symptom clusters. Conclusion: Patients with cancer and students are familiar with a similar canon of medicinal plants for the treatment of abdominal discomfort. Their common source is folk medicine. Targeted instructions*

*on evidence-based phytotherapy are needed to improve students' existing symptom-cluster-related knowledge.*

Abdominal discomfort in cancer patients may be caused by the tumour or may be due to a secondary diagnosis/concomitant disease (1). Of 482,500 new cases in 2013, 112,580 had malignant tumours of the digestive tract [except the oesophagus: ICD-10 list C16-C26 (2)]. Relevant concomitant diagnoses include inflammation-related complaints (*e.g.*, chronic inflammatory bowel disease), irritable bowel syndrome or functional dyspepsia.

For the patient, this consideration of the cause of the abdominal discomfort is initially not of importance. They have a feeling of fullness, pain of varying qualities (pressure, colic, tightness), flatulence, constipation, diarrhoea, or nausea. Secondary symptoms include malaise, loss of appetite, low mood, and a subjective loss of control over essential activities of the patient's body. In addition, from the patient's point of view, there is the social significance of these complaints: Additional stress is created; the affected person withdraws from social contacts and activities, even to the point of complete social isolation. On the other hand, patients in such phases feel very dependent on help from their environment. Personal performance is significantly reduced at work and during leisure time (3). A correlation between abdominal discomfort and decreased quality of life in affected individuals is well evidenced in gastroenterology (4, 5).

The doctor-patient relationship is also secondarily affected by abdominal discomfort. Some of those affected seek a paternalistic doctor and follow them. However, a large number feel misunderstood, pushed into the "psycho corner" and lose their compliance, and consequently their necessary adherence even in the oncological treatment. Physicians avoid talks about discomfort symptoms, based on their own uncertainty or the daily routine. Lay aetiological ideas about abdominal pain and tumours then gain ground, and complementary or even alternative treatment methods are sought (6).

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*Key Words:* Phytotherapy, self-medication, cancer patients, medical students, abdominal discomfort.



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Table I. *Analysed German-language literature on phytotherapy (ordered by symptom).*

Literature on phytotherapy screened for plants treating bloating, and fullness

- Achmüller A (2018) *Verdauung und Entschlackung*, 1<sup>st</sup> ed. Edition Raetia  
 Anonymous (2013) *Heilpflanzen: Erkennen, sammeln und anwenden*. Neuer Kaiser  
 Hoffmann P (2019) *Lexikon der Arzneipflanzen: Wegweiser zur Selbstbehandlung*. Nikol, Hamburg  
 Pahlow AM (2004) *Das große Buch der HEILPFLANZEN*. Weltbild  
 Ploss DO (2007) *Klostermedizin – Die 50 besten Tipps: Klosterheilkunde neu entdeckt 50 Alltagsbeschwerden und Krankheiten von A bis Z*. Knauer Kreativ  
 Seitz P, Engelberth J (1996) *Heil- und Gewürzpflanzen aus dem eigenen Garten*. AID. Bonn  
 Siewert AM (2019) *Gesund älter werden mit den besten Heilpflanzen: Tees, Tinkturen, Präparate & Anwendungen für mehr Lebensenergie*, 2<sup>nd</sup> ed. GRÄFE UND UNZER Verlag GmbH, Munich  
 Stange R, Kraft K (2009) *Lehrbuch Naturheilverfahren*, 1st ed. Hippokrates, Stuttgart  
 Steigerwald P-A (2015) *Phytotherapie pocket*, 3<sup>rd</sup> ed. Börm Bruckmeier, Grünwald  
 Throll A, Tomschy J (2014) *Das Kräuterwissen der Apotheker: Heilpflanzen-Rezepte für meine Hausapotheke*, 1<sup>st</sup> ed. Franckh Kosmos Verlag, Stuttgart  
 Wenigmann M (2017) *Phytotherapie: Arzneidrogen – Phytopharmaka – Anwendung*, 1<sup>st</sup> ed. Urban & Fischer Verlag/Elsevier GmbH, Munich

Literature on phytotherapy screened for plants treating constipation, diarrhoea and nausea

- Achmüller A (2018) *Verdauung und Entschlackung*, 1<sup>st</sup> ed. Edition Raetia  
 Hoffmann P (2019) *Lexikon der Arzneipflanzen: Wegweiser zur Selbstbehandlung*. Nikol, Hamburg  
 Hensel W (2020) *Welche Heilpflanze ist das?*, 4th ed. Franckh Kosmos Verlag, Stuttgart  
 Madejsky M (2019) *Praxishandbuch Frauenkräuter: Mit vielen Rezepten und praktischen Heilpflanzen-Anwendungen. Frauenheilkunde aus der Natur*, 1<sup>st</sup> ed. AT Verlag  
 Mayer JG, Uehleke B, Saum PK (2013) *Das große Buch der Klosterheilkunde*, 1<sup>st</sup> ed. ZS Verlag Zabert Sandmann GmbH, Munich  
 Ploss DO (2007) *Klostermedizin – Die 50 besten Tipps: Klosterheilkunde neu entdeckt 50 Alltagsbeschwerden und Krankheiten von A bis Z*. Knauer Kreativ  
 Schaffner W (1996) *Pflanzenführer, Heilpflanzen Kompendium, Vorkommen, Merkmale, Inhaltsstoffe, Anwendung*. Naturbuchverlag, Augsburg  
 Schönfelder P, Schönfelder I (2019) *Der Kosmos Heilpflanzenführer: Über 600 Heil- und Giftpflanzen Europas*, 4<sup>th</sup> ed. Franckh Kosmos Verlag, Stuttgart  
 Stumpf U (2021) *Unsere Heilkräuter: bestimmen und anwenden*, 3<sup>rd</sup> ed. Kosmos, Stuttgart  
 Wenigmann M (2017) *Phytotherapie: Arzneidrogen – Phytopharmaka – Anwendung*, 1<sup>st</sup> ed. Urban & Fischer Verlag/Elsevier GmbH, Munich

Typical non-medical sources of information for patients include the internet, patient brochures, and word-of-mouth information (7). The latter in particular are fed by empirical medicine. Phytotherapy is one of the oldest forms of treatment in naturopathy and has been known since ancient times (8, 9). Gastrointestinal complaints are one of the main indications for the use of medicinal plants in Europe and elsewhere (10). The literature suggests that one third of complementary and alternative medicine (CAM) use by tumour patients is based on medicinal plants (11). The trend towards the use of complementary and alternative measures is increasing, and it is estimated that about 50% of all affected people use them (12).

The current S3 guideline on supportive care in oncology patients unfortunately does not currently have a separate section on abdominal discomfort in patients. Only related symptoms such as nausea and vomiting or therapy-associated diarrhoea are discussed in detail (13).

The aim of this study was to conduct a survey on the knowledge and use of medicinal plants for abdominal discomfort among German patients with cancer and medical

school students. The main focus was on non-tumour-related complaints. Knowledge of the status quo is intended to facilitate conversation between stakeholders and professionals on the one hand, and to strengthen the foundation for practice-based student education in this area on the other.

## Patients and Methods

*Questionnaire.* We developed a questionnaire, containing a TEM-hitlist of medicinal plants against defined symptoms of abdominal discomfort. We used the algorithm already described by our group (14, 15). To obtain this hitlist, we defined the relevant symptoms, and the type of remedy collections.

Symptom selection. Recently a British group (1) defined the following six typical abdominal symptoms as significant (percentage - symptom is a reason for general practitioner consultation) in their study of 16.4 million participants from GP practices in the UK: dysphagia (0.52%), flatulence (0.61%), abdominal pain (5.42%), bowel irregularity (0.65%), rectal bleeding (1.43%), and dyspepsia (3.15%). We focus our survey on the “hidden” symptoms of flatulence/feeling full, constipation/diarrhoea and nausea. Dysphagia was excluded as a symptom of the swallowing route.

Literature selection. On the basis of common phytotherapeutic literature (10 books for diarrhoea, nausea and constipation, 11 books for fullness and bloating) by various authors in the German language (layman literature, professional literature, plant identification books), we carried out a systematic survey of traditional knowledge on the use of medicinal plants for the above symptoms. For the book list used, see Table I.

Plant selection and list. We limited ourselves to plants that are known and used as medicinal plants in Central Europe. First, all usage references/recipes for the above symptoms in the selected books were recorded. A table of the frequency of mentioning in these books was set up, which is listed in Table II. As a result, a canon of thirteen medicinal herbs was created representing the most popular plants against abdominal discomfort in German folk medicine.

#### Data collection.

*Patient survey.* The developed questionnaire recorded the knowledge and use of a medicinal plants (from the given list). Symptoms were assigned to plants and these were presented with pictures, so that recognition was also possible for patients when answering the anonymous questionnaire.

In terms of demographic data, only patient age, sex, and tumour diagnosis were recorded. The sheet was given by the Study Nurse to the patients during a tumour follow-up consultation for head and neck tumour, lymph node malignancies, and skin tumours. The nurse at the outpatient clinic was available for assistance. Period: 01/08/2020 to 30/09/2020.

*Student survey.* A questionnaire, structured analogously with respect to the plants, was programmed by us on the SoSci Survey platform and placed online. The invitation link was sent out *via* social media, and to students of the Otto-von-Guericke-University Magdeburg, Friedrich-Schiller-University Jena and Jena University of Applied Sciences asking for participation. Here, we requested anonymous information on sex, education level and field of study. Additionally, the students had the option of free text responses for their associated indications of medicinal plants in the given canon. Period: 01/03/2020 to 30/04/2020.

The data of patient-participants were transferred to an MS Excel sheet, which was used for further analysis. SoSci Survey summarised the student-participant data as an MS Excel sheet.

*Statistical methods.* At first, a descriptive analysis was performed to determine demographic data, and the level of knowledge about the recorded plants and the frequency of their use by patients and students. After this descriptive analysis of the entire dataset, a detailed analysis of the knowledge and usage for the above-mentioned five leading symptoms (bloating, fullness, nausea, diarrhoea and constipation) was performed.

Principal component analysis. For comparing data, we resorted to an algorithm already presented by our group (16). The principal component analysis was used to compare response behaviour between our two groups of participants. The resulting heat maps (Heat Map Cluster Analysis) were used to illustrate the possible differences and similarities in knowledge and usage of medicinal herbs. We have used the free ClustVis software, which is available online, for this purpose (17).

Network analysis. The students' free-text responses were subjected to network analysis. For this purpose, symptom complexes were defined out of the given answers (abdominal

Table II. Multiple responses of medicinal plants per symptom.

Symptom	Plant	Recipes	
Bloating (9)	Yellow gentian	5	
	Wormwood	4	
	Cumin/Caraway	3	
	Angelica	3	
	Fennel	3	
	Dandelion	3	
	Common juniper	2	
	Lovage	2	
	Giant hyssop	2	
	Fullness (11)	Cumin/Caraway	11
		Fennel	9
		Anise	7
		Yellowgentian	6
Giant hyssop		6	
Wormwood		5	
Rosemary		5	
Lemon balm		5	
Angelica		5	
Obstipation (12)		Flax	11
		Buckthorn	10
	Rhubarb	10	
	Senna	8	
	Psyllium seeds	8	
	Castor	6	
	Aloe (bardensis)	6	
	Fig tree	5	
	Koloquite	4	
	Diarrhoea (12)	Bloodroot	9
		Oak	9
Blueberry		9	
Common agrimony		8	
Lady's mantle		7	
Psyllium seeds		6	
Blackberry		6	
Cinquefoil		5	
Carrot		4	
Nausea (12)		Ginger	8
		Peppermint	6
	Artichoke	2	
	Mugwort	2	
	Camomile	2	
	Caraway	2	
	Lemon balm	2	
	Wormwood	2	

discomfort, sensitivities, upper respiratory tract and oral mucositis). The naming of a symptom from the complex led to the assignment of the described plant. The visualisation was performed using the program Easy Linavis *via* [www.ezlinavis.dracor.org](http://www.ezlinavis.dracor.org).

Further statistics. Demographic impact factors (age and sex) were analysed *via* univariate analysis. The information provided by the students was also screened for impact. The level of education was examined here as a possible determinant. Groups according to the impact factors were compared by independent Student's *t*-test or Mantel-Haenszel chi squared test. Differences were described as significant if the *p*-value was <0.05.

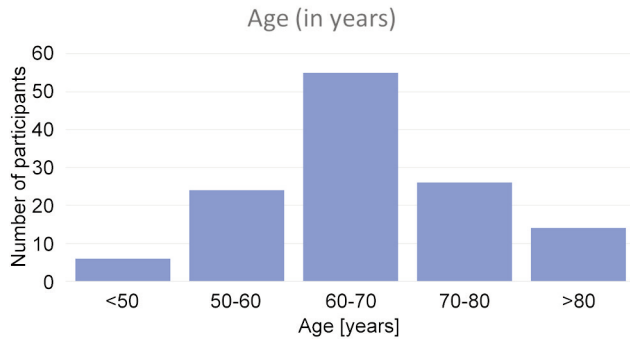


Figure 1. The distribution of patients in the different age groups.

**Ethics.** The survey was submitted to and approved by the Ethics Committee of the Jena University Medical Center (Reg. No. 2020-1866-Bef dated 31/07/2020). All the research was conducted in accordance with the currently valid version of the Declaration of Helsinki.

**Results**

*Study population.*

**Participating cancer patients.** The participating cancer patients suffered from different tumours: C01-C13 60 participants, C30-C32 43 participants, C44 12 participants, and C73 and C77 5 participants. A total of 125 patients (94 men, 31 women) were included. Their average age was 67.14±10.08 years. To prepare the impact analysis “age”, we demonstrated the age structure in Figure 1.

**Participating students.** A total of 190 fellow students participated (53 men, 129 women, 8 not specified). Of these, 174 studied human medicine, 2 dentistry and 14 other health sciences. A total of 72 students were in preclinical training at the time of the survey, 89 were in clinical semesters, 13 students were in their internship year, and 16 made no assignment. In the end, 157 interviews were included in the analysis.

**Study results.** The patients knew a median of 9 medicinal plants from the presented canon (range=2-13). They used a median of 4 of the plants mentioned (range=0-11). The proportion of non-users was 17/125 (13.6%). The students knew a median of 10 of the plants (range=0-13). They used a median of 5 plants (range=0-10). The proportion of non-users was 18/157 (11.4%). Figure 2 summarises these data and illustrates that there are no significant difference between the two groups.

**Knowledge of plants.** Botanic knowledge is the base of plants’ use in nutrition and medicine. It is noteworthy, that patients and students knew the given canon. Only seven

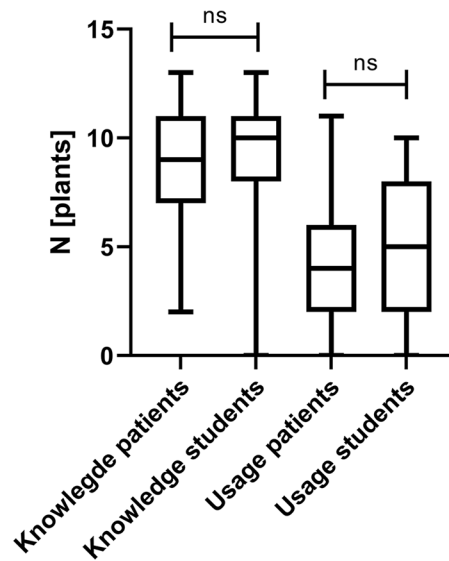


Figure 2. Box plots of knowledge and usage of medicinal plants in patients and students. No significant difference was found between the two groups.

Table III. Knowledge of medicinal plants against abdominal discomfort.

Plants	Patients		Students	
	Ranking	Rate	Ranking	Rate
Anise	8	84/125 (75.2%)	1	133/157 (84.7%)
Bilberry	4	110/125 (88%)	2	130/157 (82.8%)
Bloodroot	12	34/125 (27.2%)	12	43/157 (27.4%)
Chamomile	2	121/125 (96.8%)	10	113/157 (72.0%)
Caraway/ Cumin	7	98/125 (78.4%)	8	119/157 (75.8%)
Oak	9	72/125 (57.6%)	7	124/157 (79.0%)
Flax	10	67/125 (53.6%)	6	125/157 (79.6%)
Fennel	3	115/125 (92%)	4	128/157 (81.5%)
Ginger	4	110/125 (88%)	9	115/157 (73.2%)
Peppermint	1	124/125 (99.2%)	5	126/157 (80.3%)
Psyllium seeds	11	44/125 (35.2%)	11	107/157 (68.2%)
Rhubarb	6	106/125 (84, 8%)	3	129/157 (82.2%)
Senna leaves	13	30/125 (24%)	13	31/157 (19.7%)

students reported that they know zero of the given herbs. However, there are some further differences. More than 90% of patients knew peppermint, chamomile, and fennel. In contrast, anise, bilberry, and rhubarb were the most known herbs among medical students. Table III summarises the numeric knowledge rates of participants regarding the hitlist plants. The remarkable different rankings in both groups are supported by the principal component analysis (PCA). The heat map in Figure 3 compares the knowledge regarding

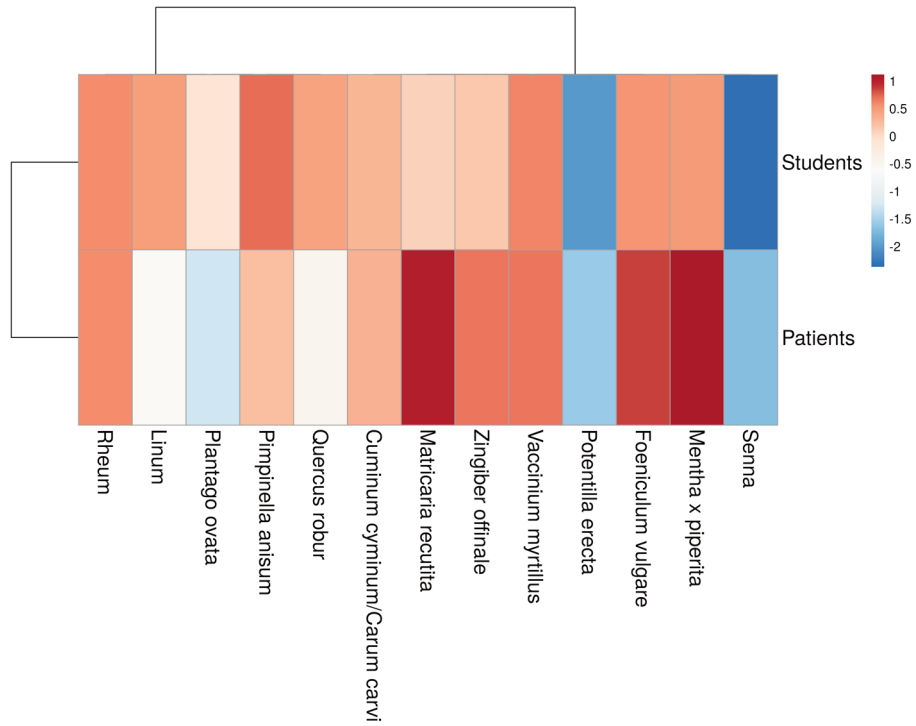


Figure 3. Assessment of knowledge of individual medicinal plants using principal component analysis. The more red-brown the tones become, the more often a plant is recognized. Blue indicates little knowledge.

each plant among the students and patients. Students had a higher knowledge on flax, oak, anise, psyllium seeds and bloodroot. In contrast, fennel, rhubarb, ginger, caraway/cumin, peppermint, senna leaves, bilberry, and chamomile were better known among the patients.

*Use as medicinal plants.* The reported use is representing the applicable knowledge regarding medicinal plants. Therefore, Table IV lists the usage of the different plants against abdominal discomfort. Here the ranking showed that patients and students had the same favourites – peppermint and chamomile. In Figure 4, the PCA-based heat map demonstrates the similar usage behavior of patients and students. But it also illustrates that in particular ginger and flax are used practically only by students. Some plants were practically not used by both groups, for example bloodroot.

The knowledge of plants not always correlated with their use. Correlation analysis (Pearson) showed a mean positive correlation in patients with  $r=0.525$  at  $p<0.001$ . This relationship was not present in the medical students ( $r=0.09$ ,  $p=0.249$ ).

The ratio between knowledge and usage represents the application security within a reporting group. We observed a use-knowledge quotient among patients ranging from 0.716 for peppermint to 0.042 for oak. Students showed use-

Table IV. Usage of medicinal plants against abdominal discomfort.

Plants	Patients		Students	
	Ranking	Rate	Ranking	Rate
Anise	8	27/125 (21.6%)	8	41/157 26.1%
Bilberry	5	51/125 (40.8%)	6	64/157 (40, 8%)
Bloodroot	12	5/125 (4%)	12	2/157 (1.3%)
Chamomile	2	82/125 (68%)	2	123/157 (78.3%)
Caraway/ Cumin	6	50/125 (40%)	7	62/157 (39.5%)
Oak	13	3/125 (2.4%)	11	3/157 (1.9%)
Flax	8	27/125 (21.6%)	5	76/157 (48.4%)
Fennel	3	75/125 (60%)	4	85/157 (54.1%)
Ginger	4	65/125 (52%)	1	125/157 (79.6%)
Peppermint	1	87/125 (69.6%)	3	97/157 (61.8%)
Psyllium seeds	10	18/125 (14.4%)	10	37/157 (23.5%)
Rhubarb	7	47/125 (37, 6%)	9	39/157 (24.8%)
Senna leaves	11	6/125 (4.8%)	13	1/157 (0.6%)

knowledge ratios ranging from 1.088 (camomile) to 0.024 (oak). Value >1 is only possible if participants have not marked a herb as known, but listed that they used the herb in daily life. Table V summarises in detail the medicinal plants

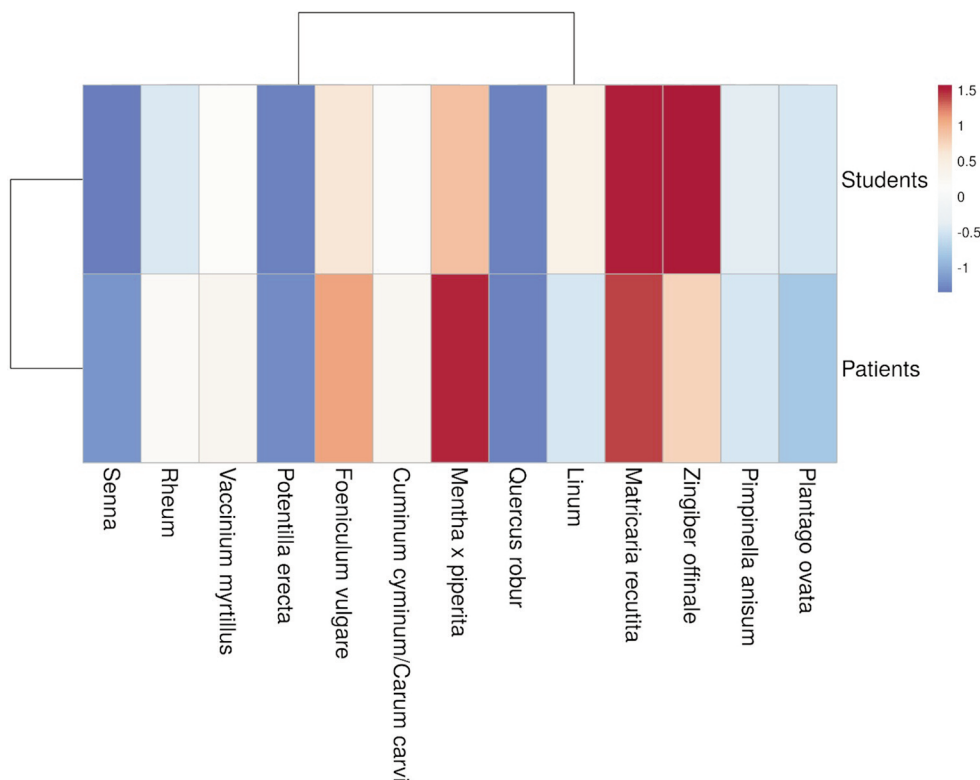


Figure 4. Assessment of the use of individual medicinal plants using principal component analysis. The more red-brown the tones become, the more often a plant is used. Blue indicates little usage.

and the quotient as a measure to estimate how often plants known to patients and medical students are also in use.

*Applicable knowledge and supposed indications.* Table VI presents the detailed knowledge and user rates for the different symptoms of abdominal discomfort. Patients used what they know: fennel against bloating and fullness, rhubarb against constipation, bilberry against diarrhoea, and peppermint against nausea. Medical students used the same herbs against bloating, fullness, and diarrhoea. Nausea was commonly treated with ginger, and flax was used against constipation. Furthermore, students knew the positive effects of anise against bloating, but did not use it.

Students' knowledge could be described by analysing the free text answers in their survey. A total of 157 students named 265 supposed indications for the use of medicinal plants in relation to abdominal complaints, *i.e.*, 1.68 "associated" indications were listed by each student. The awareness of the mentioned indication(s) for the use of a medicinal plant was distributed as follows: Fennel 53 (33.8%), flax 48 (30.6%), chamomile 39 (24.8%), psyllium seeds 31 (19.7%), anise 29 (18.5%), caraway/cumin 25 (15.9%), peppermint 19 (12.1%), ginger 13 (8.3%), rhubarb 5 (3.2%), bilberry 2 (1.3%), senna leaves 1 (0.6%), bloodroot 0, and oak 0.

Table V. Medicinal plants of traditional medicine in German-speaking countries for the treatment of abdominal discomfort\* (use-knowledge ratio per plant).

List	Patients	Students
1	Peppermint 0.716	Chamomile 1.088
2	Chamomile 0.7025	Ginger 1.087
3	Fennel 0.6522	Peppermint 0.77
4	Ginger 0.5909	Fennel 0.664
5	Cumin/Caraway 0.5102	Flax 0.608
6	Blueberry 0.4636	Cumin/Caraway 0.521
7	Rhubarb 0.4434	Blueberry 0.492
8	Psyllium seed 0.4091	Psyllium seeds 0.346
9	Flax 0.403	Anise 0.308
10	Anise 0.2872	Rhubarb 0.302
11	Senna leaves 0.2	Bloodroot 0.047
12	Bloodroot 0.1471	Senna leaves 0.032
13	Oak 0.0417	Oak 0.024

\*To compare this canon with other traditional remedies, please refer the Latin nomenclature: Peppermint (*Mentha x piperita* L.), Chamomile (*Matricaria recutita* L.), Fennel (*Foeniculum vulgare* Mill.), Ginger (*Zingiber officinale* Roscoe), Cumin/Caraway (*Cuminum cyminum* L./*Carum carvi* L.), Blueberry (*Vaccinium myrtillus* L.), Rhubarb (*Rheum* L.), Psyllium seed (*Plantago ovata* Forssk.), Flax (*Linum* L.), Anise (*Pimpinella anisum* L.), Senna leaves (*Senna* Mill.), Bloodroot (*Potentilla erecta* L.), Oak (*Quercus robur* L.).

Table VI. Usage of medicinal plants against abdominal discomfort.

Symptom	Knowledge (K) or usage (U)	Patients		Students	
		Plants	Rate (%)	Plants	Rate (%)
Flatulence	K	Fennel	92.0	Anise	84.7
		Caraway	78.4	Fennel	81.5
		Anise	75.2	Caraway	75.8
	U	Fennel	60.0	Fennel	54.1
		Caraway	40.0	Caraway	39.5
Fullness	K	Fennel	92.0	Fennel	81.5
		Caraway	78.4	Caraway	75.8
		Fennel	60.0	Fennel	54.1
	U	Caraway	40.0	Caraway	39.5
		Anise	21.6	Anise	26.1
Diarrhoea	K	Bilberry	88.0	Bilberry	82.8
		Oak	57.6	Oak	79.0
		Psyllium seeds	35.2	Psyllium seeds	68.2
		Bloodroot	27.2	Bloodroot	27.4
		Bilberry	40.8	Bilberry	40.8
	U	Psyllium seeds	14.4	Psyllium seeds	23.6
		Bloodroot	4.0	Oak	1.9
		Oak	2.4	Bloodroot	1.3
		Rhubarb	84.8	Rhubarb	82.2
		Flax	53.6	Flax	79.6
Constipation	K	Psyllium seeds	35.2	Psyllium seeds	68.2
		Senna leaves	24.0	Senna leaves	19.7
		Rhubarb	37.6	Flax	48.4
	U	Flax	21.6	Rhubarb	24.8
		Psyllium seeds	14.4	Psyllium seeds	23.6
Nausea	K	Senna leaves	4.8	Senna	0.6
		Peppermint	99.2	Peppermint	80.3
		Chamomile	96.8	Caraway	75.8
		Ginger	88.0	Ginger	73.2
	U	Caraway	78.4	Chamomile	72.0
		Peppermint	69.6	Ginger	79.6
		Chamomile	68.0	Chamomile	78.3
Ginger	52.0	Peppermint	61.8		
Caraway	40.0	Caraway	39.4		

The network analysis of free answers in Figure 5 also reveals that students were aware of plant clusters, e.g., camomile – peppermint, fennel – anise, peppermint – ginger. Other plants were more in use as individual substances including Bilberry, senna leaves, and bloodroot. The shown clusters are also presented in Table VI. The mentioned combinations of herbs are related to different symptoms.

*Influencing factors.* Patients: In the determinant analysis, female sex was shown to have a positive influence on plant knowledge. There was no influence on the use of medicinal plants. Age had no influence on the answers. Detailed data are shown in Table VII.

Students: Within medical school, the training section had no impact on the knowledge and use of medicinal plants.

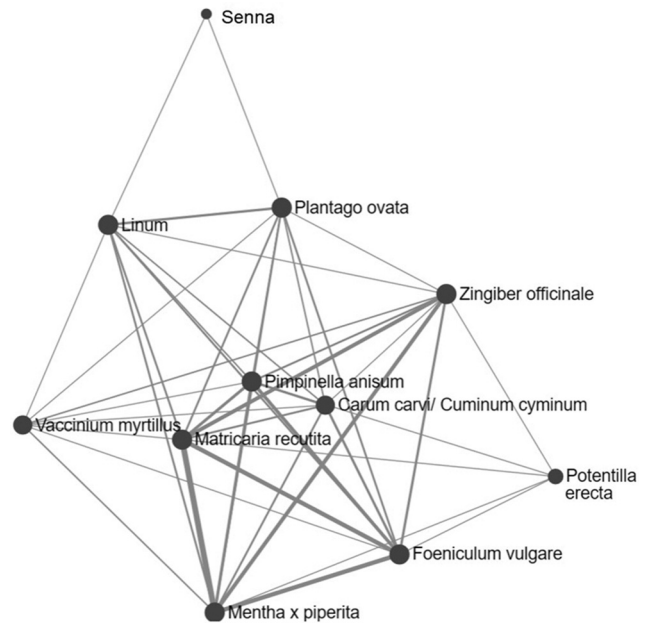


Figure 5. Network analysis of indication knowledge among students. The larger the node, the more indications per plant. The wider the axis, the more common the indications.

Table VII. Factors affecting knowledge and usage of medicinal plants.

		Median number of known plants (range)	Median number of used plants (range)
Patients	Age <60 years	9.5 (2-13)	4 (0-9)
	Age >60 years	9 (3-13)	4 (0-11)
		$p=0.624$	$p=0.634$
	Male	9 (2-13)	4 (0-10)
	Female	11 (4-13)	4 (0-11)
		$p=0.009$	$p=0.788$
Students	Pre-clinical semester	10 (0-13)	5 (0-10)
	Clinical semester	10 (0-13)	5 (0-10)
		$p=0.613$	$p=0.386$

**Discussion**

To our knowledge, the presented data are the first about self-medication against abdominal discomfort in the context of cancer and cancer treatment. People know plants, and only 13.6% of our tumour patients were not using herbs in the context of abdominal discomfort. Such data shows, the knowledge and use of medicinal herbs is an important part of CAM and have to be part of the patient-doctor-interactions. Furthermore, the syndrome of abdominal discomfort is considered to be one of the main symptoms

that compromise quality of life and life satisfaction of patients. Because of the known psychological overlays, this applies to vulnerable groups such as patients with cancer in particular (18, 19).

*CAM against abdominal discomfort.* Nearly 90% of patient participants were using herbs in the case of abdominal discomfort. Probably the role of medicinal herbs is underestimated in the current literature about CAM among patients with cancer. All of our participants (patients as well as students) had a very high level of knowledge regarding herbs. Therefore, the high user rates were not a real surprise. However, they were in contrast to reports from the literature. About 40-50% of all patients with cancer in Germany seek and use complementary or alternative treatment approaches (7). One of the most frequently-mentioned therapeutic goals for using phytotherapy is to alleviate side effects of cancer therapy or symptoms related to the tumour (12). Phytotherapy is used only at rates <10%. The reason for this observation is unknown. Sometimes, medicinal herbs might not be reported, because patients do not classify application of herbal medicine in daily life (e.g., herbal teas) as CAM. Behavioural-psychological support, acupuncture, and moxibustion are well known CAM methods against abdominal discomfort (20-25). These (sometimes plant including) procedures are used especially in Southeast Asia. Wraps, washes, and especially massages are typical procedures in complementary care; specific phytotherapy also has a long tradition in some regions of the world (26, 27). Dietary measures, including probiotics, also occupy a separate position (28, 29).

To understand this hidden role of medicinal herbs in supportive care for patients with cancer, we have to reflect that phytotherapy generally involves the treatment of symptoms or diseases with plants, their parts or their ingredients.

In 2020, sales of typical phytopharmaceuticals in Germany amounted to 856 million Euros (excluding homoeopathy and anthroposophical preparations). Stomach and digestive products were the fourth-largest item, with sales of 128 million Euros. In addition to classic self-medication, there is the area of medically prescribed preparations that are taken by patients and for which they have to pay for themselves (30).

*Plants against abdominal discomfort.* We presented a first canon of herbs, which are traditionally used against abdominal discomfort in Germany. Peppermint, chamomile, and fennel are used in daily practice among our patients with cancer. Here, the basic pool of knowledge is folk medicine and their written remedies. This is in contrast to common CAM use in oncology. Normally, little is known about specific sources of CAM information and detailed indications (31).

Table VIII. Medicinal plants of traditional Persian (Iranian) medicine for the treatment of abdominal discomfort (Pasalar et al.)

Plant	Latin name	Indication
Celery	Apium graveolens L.	Ulcer prevention
Radishes	Raphanus sativus L.	
Eruca sativa	Eruca sativa Mill.	Anti-inflammatory effect
Marjoram	Origanum majorana L.	
Amla Tree	Phyllanthus emblica L.	
Noble grape vine	Vitis vinifera L.	
Nutmeg tree	Myristica fragans Houtt.	
Spanish pepper	Capsicum annum L.	Functional dyspepsia
Liquorice	Glycyrrhiza glabra L.	
Real black cumin	Nigella sativa L.	

To understand the specific role of medicinal herbs against abdominal discomfort, we focus on other medical cultures. Also referring to the unclear definition of symptoms – described above – Pasalar *et al.* collected the possible traditional Persian/Iranian medicinal plants (32), which we summarised again in Table VIII; there are some differences to our German canon. In Japanese Kampo medicine, there is also a number of defined plant mixtures (Table IX) that are part of traditional recipes and have proven pharmacological targets (33). Some frequently used plant mixtures are also known from the field of traditional Chinese herbal medicine. In a Systematic Review, a small effect was described from 27 randomised controlled trials on Si-Mo-Tang, but the study quality was very low (34). The situation is similar for the traditional Chinese formulation Tong-Xie-Yao-Fang (35). Other Southeast Asian cultures also have hidden recipes in folk medicine: Individual controlled studies are available from Korea, for example, on Samryungbaekchul-san (36). There are studies on the compound Padma Lax used in traditional Tibetan medicine, but the patient number is also very low with 61 patients (37) and 37 participants (38), so that no conclusions on efficacy should be drawn here either.

In both traditional Persian medicine and Kampo medicine, the authors emphasise the lack of or insufficient data from clinical trials in the sense of evidence-based medicine. There is a similar situation for the presented folk medicine-based German canon. Regarding our list, only a few reviews and RCTs were identified. Thus, there is a controlled study on peppermint (as an oil) with quite a positive effect on functional abdominal symptoms, but tumour patients with their additional features were almost never considered as a study population (39). Camomile has been co-tested in the drug combination STW3 (Iberogast®) as a medicinal plant helping with abdominal discomfort (40), though individual studies are more available in the context of oral mucositis (14). For the combination of STW3 with *Angelica*



Table IX. Medicinal plants of Kampo medicine for the treatment of gastrointestinal complaints (Tominaga *et al*. 2013)

Enteritis, Colitis, IBS	Daikenchuto	Panax ginseng Zanthoxylum piperitum Zingiber officinale
	Hangeshashinto	Coptis japonica Glycyrrhiza uralensis Panax ginseng Pinellia ternata Scuteelaria baicalensis Zingiber officinale Zizyphus jujuba
FD, gastritis	Rikkunshito	Atractylodes lancea Citrus aurantium Glycyrrhiza uralensis Panax ginseng Pinellia ternata Poria cocos Zingiber officinale Zizyphus jujuba
	Hangeshashinto	Coptis japonica Glycyrrhiza uralensis Panax ginseng Pinellia ternata Scuteelaria baicalensis Zingiber officinale Zizyphus jujuba
	Hangekoubokuto	Magnolia obovata Perilla frutescens Pinellia ternata Poria cococ Zingiber officinale
	Gosuyuyuto	Evodia rutaecarpa Panax ginseng Zingiber officinale Zizyphus jujuba

IBS: Irritable bowel syndrome; FD: functional dyspepsia.

*archangelica* L. (Medicinal angelica), *Matricaria chamomilla* L. (Camomile), *Carum carvi* L. (Caraway), *Silybum marianum* L. (Milk thistle), *Melissae folium* (Lemon balm), *Menthae x piperitae* L. (peppermint), *Chelidonium* L. (greater celandine), *Glycyrrhiza glabra* L. (liquorice), and *Iberis amara* L. (bitter candytuft), further randomised studies with clinical proof of efficacy are available (41). Overall, the effect is considered to be statistically significant, but not clinically significant (42). There are also individual reports for bloodroot (43) and cumin [both in our list (44)], as well as marjoram (43). We found no other recent clinical work on the topic at a Western setting.

**Risk of self-medication.** People know a lot of herbs and some traditional remedies, and thus our “median patient” knows 9 plants and uses 4 of them against abdominal discomfort. Looking at the canon of traditional European (German) plants, only a minority are likely to be actual

phytopharmaceuticals, while the majority are used in teas, extracts, salads and other preparations. In no field of complementary medicine are dietetics and pharmacological effects likely to be so juxtaposed as in phytotherapy. It is precisely this situation that leads to a problem that is particularly explosive in patients with cancer– the interactions between basic treatment and self-prescribed complementary medicine. Conservative estimates suggest that this is likely to be a factor in 55% of oncology patients on CAM self-medication (45). Recently, Wolf and colleagues reported that in 37.5% of patients, these interactions between cancer therapy and self-medication are due to classical phytopharmaceuticals. In addition, in 28.7% of patient interactions between cancer therapy and medicinal plants occurs in the context of nutrition. Since >50% of patients do not report their self-medication, this figure alone results in a high number of unreported effects that need to be uncovered to prevent harm to the patient and to ensure effective therapy (46). The problem should be illustrated by an example: 70% of our patients are using peppermint against abdominal discomfort. Enhanced bowel activity will be a typical effect with its full consequences for any oral/enteral medication and/or nutrition.

**Phytotherapy education of medical students.** Medical Students know and use the same traditional herbs against abdominal symptoms. Despite their youth, they have a high level of knowledge in medical plants. Only in some fields they show to be more informed than their patients. Thus, they know ginger for treating nausea, or anise for treating bloating. But they are seldomly able to transfer this knowledge to their practice.

According to the data available here, the source of knowledge in both populations studied (students as well as patients) is currently likely to be folk medicine rather than university education (15). Figure 3, on the other hand, illustrates the necessary transfer of knowledge between the two groups. If the students know more, these plants can be used in a more targeted way. If students know less, their knowledge needs to be increased.

There is a characteristic gap in students’ answer profile. Network analysis is a valuable tool to document which symptom-cluster is associated with certain plants. Gaining an overview of the current knowledge of medical students is a good base for improving education on phytotherapy. Especially as the participants are not always able to describe the correct indication for a single medicinal plant. Bilberries are the most divergent example – all students (82.8%) know the plant, nearly nobody (1.3%) was able to tell the right indication. We have to bridge this gap. It should be an important task of further education at universities.

Depending on the generation, patients obtain their information from the internet or classic advice. Personal

advice by family members, doctors and pharmacists will remain a base for our patients with cancer in the future too. From this point of view, determining the level of knowledge of young physicians is of particular importance. In the classic consultation situation, the young doctor then encounters unsettled patients who want to treat their hidden complaints with home remedies but do not want to disturb the tumour therapy (and the doctor). This situation can be improved using two approaches: First, the herbal consumed must be discussed in principle and repeatedly between the patient with cancer and physician (standard of communication). On the other hand, there is a need for professional knowledge on the part of medical professionals on issues related to phytotherapy and medicinal herb usage (medical education).

Knowledge of indications, interactions and closing the knowledge gap in terms of evidence-based medicine are necessary to ultimately lead to an improvement in complementary medicine care in the field of phytotherapy for patients with cancer. The recently published data on the quality of complementary medicine offered in German general teaching practices illustrates the significant problem of this issue (47).

*Limitations of the study.* To avoid over-interpretations of the presented results, it is necessary to discuss the limitation of the study: i) Abdominal discomfort is not clearly defined. Our canon of medicinal plants is limited to the hidden symptoms bloating, fullness, nausea, constipation and diarrhoea. Abdominal pain therapy is an additional major clinical problem. ii) We have used a barrier-free concept of study participation. Participants got name, picture and possible indications of the plants and were asked to mark knowledge and usage. Probably lower rates of active knowledge are realistic. iii) Abdominal discomfort of our patients was the result of cancer treatment or secondary diagnosis as inflammation or functional disturbances. Specific lower GI-cancer associated symptoms were not a subject of this study. iv) Participating patients were asked at one hospital. These answers of the group could be specific for the region of origin. v) Participating students came from different German universities. There is no standardised level of CAM education in medical studies in Germany. So, the answers of students could be locally specific too. vi) Both surveys were performed during Covid-19 pandemic. New media have got new role during this time. Easier accounts to web-based information offer new developing fields of CAM use.

## Conclusion

Knowledge of the medicinal plants used is essential for oncologists. Patients with cancer use mint, camomile, fennel and ginger for abdominal discomfort; medical students tend

to use ginger too. The existing broad knowledge from folk medicine should facilitate communication about the self-medication that actually takes place. To date, evidence-based knowledge is rare in phytotherapy of the discussed field. We observed that indications of plants are associated with a specific symptom-cluster. This already existing knowledge of medical students needs to be backed up with evidence-based knowledge in medical training.

## Conflicts of Interest

The Authors have no conflict of interest to declare relative to this study.

## Authors' Contributions

S.K.B. recruited participants. S.K.B., O. M. and J. B. wrote the manuscript. S. K. B. and J. B. did statistical and informatics analyses. O. M. and J. H. supervised the project. All Authors edited and reviewed the manuscript during the writing process.

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