

## ORIGINAL ARTICLE

# Prevalence of Wine Intolerance

Results of a Survey From Mainz, Germany

Petra Wigand, Maria Blettner, Joachim Saloga, Heinz Decker

## SUMMARY

**Background:** Wine is an ancient food product, ubiquitous across cultures all over the world. Its effects on health have been extensively studied, yet there have been only a few case reports of wine intolerance or wine allergy. We studied the prevalence of self-reported wine intolerance in the adult population of Mainz, Germany.

**Methods:** In 2010, a questionnaire-based cross-sectional study was conducted to assess the prevalence of wine intolerance among adults in Mainz, a city in the wine-cultivating area of Rhine-Hesse. 4000 persons randomly chosen from population lists were asked to fill out a questionnaire about their alcohol intake and the occurrence of various intolerance reactions and allergy-like symptoms after drinking wine.

**Results:** Of the 4000 who received the questionnaire, 948 (23.7%) filled it out and returned it to us. 68 (7.2% of respondents) reported intolerance to wine and/or allergy-like symptoms after drinking wine. Self-reported wine intolerance was more prevalent in women than in men (8.9% vs. 5.2%,  $p = 0.026$ ). Wine-intolerant persons also more commonly reported intolerance to beer and alcohol in general. Allergy-like symptoms were more common after the consumption of red wine. The most commonly reported reactions to wine were cutaneous flushing, itch, and nasal congestion.

**Conclusion:** Wine intolerance was found to be more common than expected. The data reported here are less suggestive of an immunologically mediated allergy than of intolerance to alcohol, biogenic amines, or other ingredients of wine.

### ► Cite this as:

Wigand P, Blettner M, Saloga J, Decker H: Prevalence of wine intolerance: results of a survey from Mainz, Germany. *Dtsch Arztebl Int* 2012; 109(25): 437–44. DOI: 10.3238/arztebl.2012.0437

**W**ine consumption has been popular for millennia in many cultures. In recent decades, many studies have revealed the positive effects on health that wine can have, especially long-term effects after moderate wine consumption (1–3). However, isolated cases of allergic reactions, which can be very severe, have also been reported (4–11). No epidemiological studies examining the frequency of wine intolerance in a general population have yet been published. The aim of this study is to assess how widespread wine intolerance is in a wine region. The data thus obtained can serve as a basis for further studies on wine intolerance. The basis of this study is a questionnaire survey about wine consumption and the incidences of allergies and allergy-like symptoms following wine consumption.

## Methods

In 2010, 4000 people between the ages of 20 and 70 years were randomly selected from the approximately 145 000 residents of Mainz by the Mainz Registration Office. A short questionnaire about wine consumption and wine tolerance were sent to these selected people. The study was approved by the Data Protection Officer at the University Hospital in Mainz, and by the Ethics Committee of the State of Rhineland-Palatinate. Of these, 1114 questionnaires (27.9%) were returned. For the final evaluation, all completed questionnaires from people aged 20 to under 70 years were taken into account ( $n = 948$ ); 166 questionnaires were incomplete and not included.

The questionnaire comprised questions on age, sex, and the average weekly consumption of wine, beer, and liquor during the past year. Questions also included whether allergy-like symptoms had occurred after wine consumption; for this, participants were given a list of symptoms experienced after consuming white or red/rosé wine. Participants were also asked about the frequency of occurrence of each symptom (with the options of once, seldom, frequent, or always). In addition, participants were questioned about intolerance to pollen, house dust, latex, medications, seafood, nuts, milk, apples, cherries, oranges, peaches, plums, kiwis, strawberries, grapes, bananas, carrots, peppers, alcohol or beer; if they reported any intolerances, they were asked whether these were medically diagnosed. Because the study relied on self-reporting and not on formal medical diagnosis, all reported symptoms except for headache were considered as symptoms of intolerance.

Institute of Molecular Biophysics of the Johannes Gutenberg University Mainz:  
Dr. rer. nat. Wigand, Prof. Dr. rer. nat. Decker

Institute of Medical Biostatistics, Epidemiology and Informatics (IMBEI) at the  
University Medical Center of the Johannes Gutenberg University Mainz:  
Prof. Dr. rer. nat. Blettner

Department of Dermatology of the Johannes Gutenberg University Mainz:  
Prof. Dr. med. Saloga

**TABLE 1**

**Symptoms of wine intolerance**

Symptoms	Score Points
Circulatory collapse	10
Shortness of breath/asthma	8
Tachycardia	7
Itching	6
Flushed skin	5
Swelling of lips, mouth, throat	5
Low blood pressure	5
Rhinorrhea	4
Burning sensation in lips, palate, neck	4
Stomach or intestinal cramps	3
Diarrhea	3
Vomiting	3

Several possible symptoms for intolerance were listed in the questionnaire (Table 1). Participants were classified as „persons with wine intolerance“ if the sum of the symptom scores was greater than 10, or if they self-reported having a wine intolerance.

Overall, the evaluation was mainly descriptive; to compare frequencies, p-values based on the Mann-Whitney U test were used. Since this is an exploratory study, we avoided the term “statistically significant” and instead focused on discussing differences that cannot be explained by random “variation.” Statistical analyses were performed using SPSS (version 19.0 for Windows).

**Results**

A total of 948 questionnaires were analyzed in the study. The mean age of study participants was 43.7 years, with 429 (45.3%) men and 519 (54.7%) women. The distribution for age and sex was comparable to the Mainz population, with a slight underrepresentation of younger people.

Of the 948 participants, 800 reported that they had drunk alcohol during the past year. Wine was consumed by 726 people (76.6%), with an average of 3.66 glasses per week and with slightly more white than red wine (the amount of rosé was negligible). Beer was consumed by 467 of the respondents, and liquor, by only 172.

Overall, men drank more wine than women (p = 0.001); however, when taking into account only people who consume alcohol, no difference in the amount of wine consumed by men and women was detected (p = 0.399; Table 2).

Thirty participants (3.2%) stated that they have an intolerance to wine (9 men and 21 women). Only one

man and one woman reported that a wine allergy had been verified by a physician.

A further 225 people (24%) reported allergy-like symptoms after drinking wine. The occurrence of headaches, although reported by 223 people, was not considered to be a symptom of wine intolerance, since headaches can have very diverse causes and are therefore considered non-specific.

All symptoms after wine consumption reported by the 948 participants are summarized in Table 3. Interestingly, more people reported symptoms after drinking red wine than after white wine.

A wine intolerance score of over 10 was observed for 52 of the 225 people who reported symptoms. However, only 14 of these 52 people reported that they suffered from wine intolerance, while five people gave no information about symptoms. For this analysis, we joined these two groups of people, that is, group 1, who reported having wine intolerance (n = 30), and group 2, who did not indicate having a wine tolerance but whose scores were higher than 10 (n = 38), into a single group of people with wine intolerance (n = 68) (Figure 1).

The following symptoms were reported by the 68 people with wine intolerance (Table 3):

- flushed skin, 39 people (57.4%)
- itching, 24 people (35.3%)
- rhinorrhea, 22 people (32.4%)
- diarrhea, 19 people (27.9%)
- tachycardia, 17 people (25.0%)
- stomach or intestinal cramps, 17 persons (25.0%).

In addition, participants were asked about the frequency of symptoms (Table 4). Of 68 people with wine intolerance, 39 reported having flushed skin; of these, 36 gave information about the frequency of this symptom. It occurred often or always for 25 people (36.8%), while only 34 of the remaining 880 study participants reported flushed skin. Of these 880 people, only 15 of the 32 participants who experienced flushed skin reported that it occurred often or always (1.6%). A similar situation was observed for the symptom of itching (Tables 3 and 4).

Only two people reported circulatory collapse after wine consumption. This serious reaction to wine consumption occurred only once or seldom.

Study participants were also asked about other food intolerances as well as reactions to pollen, house dust, latex, and medications (Figure 2). Not considering alcohol intolerances, 209 people (22%) reported food intolerance, with a higher prevalence in women (25%) than in men (18%). The most common triggers were nuts (10.3%), apples (7.5%), and milk (6.2%). Additionally, participants reported intolerance to pollen (31.4%), house dust (18.7%), and medication (12.0%). In many cases, participants reported that an allergy was confirmed by physicians (Figure 2); this was not the case for intolerance to alcohol, beer, or wine.

The 68 participants with a wine intolerance reported more frequently that they had other intolerances than did the remaining study participants. Thus, 15 of them

**TABLE 2**

**Average wine consumption (0.2 L-glasses per week)**

a) all study participants																	
Total study participants									Participants with wine intolerance								
Total n = 948			Men n = 429			Women n = 519			Total n = 68			Men n = 22			Women n = 46		
MV	95% CI	Median	MV	95% CI	Median	MV	95% CI	Median	MV	95% CI	Median	MV	95% CI	Median	MV	95% CI	Median
2.80	2.55 to 3.06	2.00	3.30	2.87 to 3.73	2.00	2.39	2.11 to 2.68	1.00	2.27	1.51 to 3.02	1.00	1.73	1.07 to 2.39	1.50	2.52	1.44 to 3.61	1.00

b) all study participants who are not abstinent to alcohol																	
Total study participants									Participants with wine intolerance								
Total n = 800			Men n = 389			Women n = 411			Total n = 58			Men n = 19			Women n = 39		
MV	95% CI	Median	MV	95% CI	Median	MV	95% CI	Median	MV	95% CI	Median	MV	95% CI	Median	MV	95% CI	Median
3.22	3.04 to 3.61	2.00	3.64	3.17 to 4.11	2.00	3.02	2.69 to 3.36	2.00	2.66	1.80 to 3.51	2.00	2.00	1.32 to 2.68	2.00	2.97	1.74 to 4.21	2.00

MV, mean value; 95% CI, 95% confidence interval

also reported intolerance to beer, and 19, to alcohol in general. Almost all of these belong to the group of 30 people with a self-reported wine intolerance (14 people with a beer intolerance, and 16 with an alcohol intolerance).

Of the 68 participants with wine intolerance, 18 did not drink wine, and ten did not drink alcohol at all. This wine intolerance group reported drinking an average of 2.27 glasses of wine per week (95% CI, 1.51 to 3.02); this average was 2.66 glasses of wine per week (95% CI, 1.80 to 3.51) when only those who drank alcohol were considered. No difference in average wine consumption was observed between the 68 people with wine intolerance and the 880 people who had no wine intolerance ( $p = 0.413$ ); this also holds true if only the alcohol consumers are analyzed ( $p = 0.310$ ).

**Discussion**

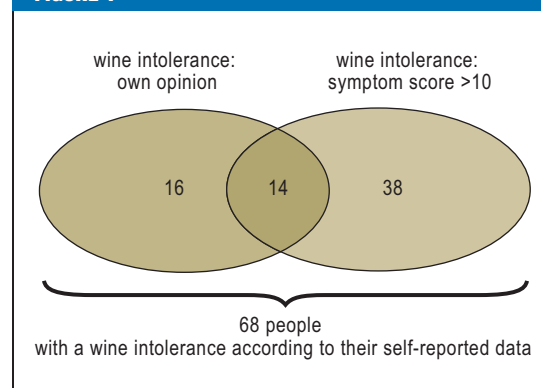
The present study provides the first data on the frequency of wine intolerance in a general population. The study is based on a questionnaire survey of randomly identified residents of the city of Mainz, which is located in a German wine growing region. A total of 68 people (7.2%; 95% CI, 5.6 to 8.8) were identified as having wine intolerance. The increased incidence of hypersensitivity reactions in women supports previous studies that showed a similar distribution for food intolerances (12, 13).

The study shows no difference in wine consumption among people with wine intolerance and the remaining study participants. One reason for this could be that people with wine intolerance have switched to drinking wines that are better tolerated; however, this possibility was not explored in the questionnaires. Another possible explanation is that the intolerance is strong enough to prevent them from drinking wine altogether.

The validity of this study is limited by the low return rate of the questionnaires, as this can lead to selection bias and thus to an over- or underestimation of the prevalence of intolerance (14). A non-responder analysis was not performed. However, in the extreme case that all wine intolerant individuals responded, the resulting prevalence of 1.7% (68 out of 4000 people) can be considered to be the lower limit. Thus, the prevalence of wine intolerance is much higher than previously thought and occurs at a similar rate as other common food intolerances.

Indeed, the number of people with a wine intolerance could also be higher, since the non-specific symptom of headaches was not considered. Nonetheless, it cannot be ruled out that headaches occur in some individuals as a symptom of intolerance. The same applies to people who reported that they only experienced one symptom after wine consumption and were thus excluded because of the limit set for symptom scores,

**FIGURE 1**



**Number of study participants with a wine intolerance according to either their own opinion or to the intolerance score**

**TABLE 3**

**Frequency of symptoms after wine consumption<sup>\*1</sup>**

Symptoms	Total participants (n = 948)				Participants with self-reported WineIN (n = 68)			
	after wine consumption in general <sup>*2</sup>	after WW	after RW	after RW and WW	after wine consumption in general <sup>*2</sup>	after WW	after RW	after RW and WW
	n (%)	n	n	n	n (%)	n	n	n
Flushed skin	73 (7.7)	14	31	24	39 (57.4)	6	16	14
Rhinorrhea	57 (6.1)	9	24	20	22 (32.4)	1	8	12
Diarrhea	57 (6.1)	12	24	15	19 (27.9)	1	7	7
Stomach or intestinal cramps	48 (5.1)	14	18	10	17 (25.0)	1	9	3
Vomiting	32 (3.4)	10	7	9	8 (11.8)	1	3	1
Tachycardia	33 (3.5)	3	17	9	17 (25.0)	1	6	6
Itching	31 (3.3)	6	12	10	24 (35.3)	5	7	9
Burning sensation of lips, palate, neck	20 (2.1)	6	8	4	8 (11.8)	0	7	1
Skin rash, hives, edema	19 (2.0)	4	9	3	15 (22.1)	3	6	3
Swelling of lips, palate, throat	15 (1.6)	2	11	2	8 (11.8)	1	5	2
Low blood pressure	13 (1.4)	4	3	4	5 (7.4)	1	0	2
Asthma/shortness of breath	9 (1.0)	3	4	2	7 (10.3)	2	3	2
Circulatory collapse	2 (0.2)	0	2	0	2 (2.9)	0	2	0

<sup>\*1</sup> More than one answer was possible. RW stands for red wine, WW for white wine, and WineIN for wine intolerance.

<sup>\*2</sup> Some participants did not state whether symptoms occurred following red or white wine consumption.

The results from these are included in the column "after wine consumption in general" but not in the columns specific for red or white wine

since individual symptoms could nonetheless be indicative of an intolerance reaction, especially if they occur often or always following wine consumption. Therefore, adding up the various symptoms to determine whether a wine intolerance is present may not always be appropriate for individual cases.

A further limitation of this study is that it is based on data from a questionnaire that has not yet been validated. Thus, our analysis of the frequency of wine intolerance was based on self-reported data, which are now being tested by clinical research.

The frequencies of intolerances were comparable with those reported in other studies. Thus, a pollen allergy was reported in the present study by 31.4% of respondents (95% CI, 28.5 to 34.4), whereas a recent study, which included skin prick tests, reported a rate of sensitization to common allergies such as birch pollen of 24.2%, and from grasses, of 37.8% (15). Overall, 51.4% of respondents in the present study (95% CI, 48.2 to 54.6) reported intolerance reactions, while the frequency for an allergic disease in Germany is around 40% (16). Whether any association between the occurrence of wine intolerance and socio-economic or demographic factors exists was not considered in this study.

The study shows that symptoms of intolerance were more frequently reported after drinking red wine than white wine. Wine contains small amounts of proteins, which mainly come from grapes but can also be introduced by bacteria and yeast (17, 18). One of the proteins found in wine is the lipid transfer protein (LTP), which has been shown to come from grapes and to be structurally stable (19). LTP is a recognized allergen (11) and can lead to serious symptoms such as anaphylaxis (20). However, it has been shown that drinking wine on a regular basis can lead to the development of oral tolerance to LTP and reduce the risk of anaphylaxis (20). LTP is located on grape skins, which are also present in the mash during the fermentation of red wine. In contrast, the must used to produce white wine is fermented without grape skins. This may explain why red wine evokes intolerance symptoms more frequently than white wine. Other proteins that have also been discussed as potential allergens, such as thaumatin-like proteins, endochitinases, and glucanases, are present in equal amounts in red and white wine (6, 10).

In addition to these allergens, other ingredients, such as sulfite or the biogenic amines of histamine and tyramine, may also evoke intolerance reactions (21, 22).

**TABLE 4**

**Frequency of symptom occurrence after wine consumption\*<sup>1</sup>**

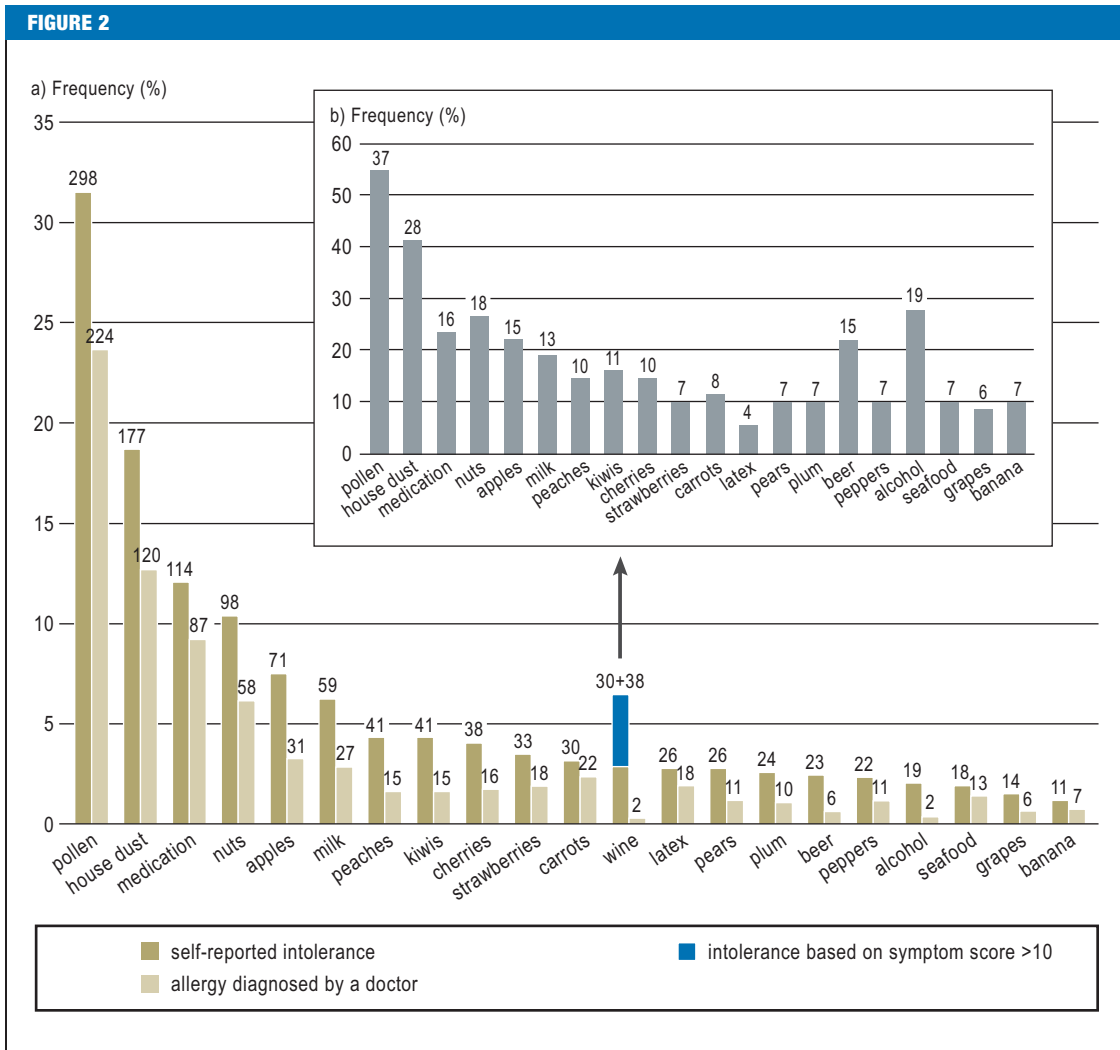
Symptoms	Total participants n = 948				Participants with self-reported WineIN n = 68					Participants without WineIN n = 880
	once	seldom	often	always	once	seldom	often	always	often + always	often + always
Flushed skin	4	24	26	14	3	8	19	6	25 (36.8%)	15 (1.6%)
Diarrhea	8	32	10	3	0	12	5	2	7 (10.3%)	6 (0.7%)
Rhinorrhea	0	23	21	7	0	11	5	5	10 (14.7%)	24 (2.7%)
Stomach or intestinal cramps	4	28	12	3	1	11	4	1	5 (7.4%)	10 (1.1%)
Vomiting	9	18	5	0	1	4	3	0	3 (4.4%)	2 (0.2%)
Tachycardia	2	14	12	3	1	6	5	3	8 (21.1%)	7 (1.0%)
Itching	0	10	12	6	0	8	8	6	14 (16.2%)	4 (0.5%)
Burning sensation in lips, palate, neck	1	15	3	0	0	7	1	0	1 (1.5%)	2 (0.2%)
Skin rash, hives, edema	3	7	7	1	3	5	5	1	6 (8.8%)	2 (0.2%)
Swelling of lips, palate, throat	1	9	2	2	0	5	0	2	2 (2.9%)	2 (0.2%)
Low blood pressure	1	6	3	1	1	3	0	0	0	4 (0.5%)
Shortness of breath, asthma	0	4	4	0	0	3	4	0	4 (5.9%)	0
Circulatory collapse	1	1	0	0	1	1	0	0	0	0

\*<sup>1</sup> Only participants who provided information about symptoms after wine consumption were considered; WineIN stands for wine intolerance

**Frequency of intolerance on the basis of self-reported data**

a) Of the 948 participants, 30 reported having a wine intolerance (3.2%; olive-green bars) while an additional 38 had intolerance scores of over 10 (4.0%; blue bars)

b) Details for the 68 people with wine intolerance; the number of affected people in each category is shown over each bar



In general, German wines contain very low amounts of total biogenic amines, but these are present in red wines at a higher concentration than in white wines (23).

Alcoholic drinks in general, and in particular red wine, seem to be important triggers for intolerance (24, 25). In this study, 19 of the 68 people with wine intolerance (25%) also reported a general intolerance to alcohol. This could therefore indicate that a more generalized intolerance to alcohol is one of the causes for the observed wine intolerance. Such an intolerance could have several causes:

- polar and hydrophobic ingredients in wine could be dissolved in alcohol, thereby promoting their absorption into the body;
- alcohol promotes the permeability of the intestinal mucosa, which could increase the absorption of wine ingredients;
- alcohol-induced vasodilation could also be responsible for some symptoms of wine intolerance, such as skin flushing;
- alcohol inhibits the enzyme diaminoxidase,

which degrades histamine and other biogenic amines. This would increase histamine concentrations and could lead to symptoms such as vascular dilation in the nose region (21, 22).

The fact that only 3 out of 30 participants with self-reported wine intolerance and 6 out of the total of 68 wine-intolerant individuals identified in our study additionally reported grape intolerance, supports the assumption that wine intolerance is very rarely caused by true allergy to grapes.

**Non-allergic wine intolerance versus wine allergy**

It is very likely that most people can not distinguish between an allergy and a non-allergic intolerance, as symptoms of a true IgE-mediated food allergy are very similar to those in non-allergic intolerance. Therefore, direct responses to questionnaires often overestimate the incidence of food allergy, as compared to studies that specifically analyze for IgE or that use prick tests (12, 26).

Only 2 of the 68 people with wine intolerance reported having medically diagnosed wine allergy. However, since the respondents did not indicate which specific tests were performed, a diagnosis of wine allergy cannot be regarded as certain. An allergy to wine or grapes is not routinely tested for, unlike for example sensitization to pollen. This might explain the higher proportion of medically diagnosed allergies to other agents. In summary, on the basis of the present study and the few existing reports on wine allergy in the literature, we can conclude that wine is a relatively safe food material, in relation to true allergy. However, this study shows that a relatively high percentage of people (23.7%) report having intolerance symptoms after drinking wine. This study demonstrates that the relative frequency of individuals with a self-reported intolerance to wine (n = 30) is comparable to the relative frequency of people with intolerances to other foods (Figure 2).

### Conclusion

A surprisingly large number of people reported having experienced symptoms after drinking wine, and the number of these symptoms was also higher than expected. The frequency of people who appear to have wine intolerance based on their reported data is comparable to the incidence of people with other common food intolerances. Wine intolerance seems to be a relatively common phenomenon within the general population, and this should be considered during medical examinations if the patient presents with the relevant complaints. Further clinical studies are necessary to distinguish true wine allergy from other causes of wine intolerance, such as those caused by alcohol, sulfites, or biogenic amines.

### Acknowledgment

This study was funded by the Foundation Rheinland-Pfalz for Innovation and by the Johannes Gutenberg University, Mainz. The authors thank Melanie Kaiser for her help in designing the questionnaire and data processing.

### Author contributions

The authors Peter Wigand, Maria Blettner, and Heinz Decker contributed equally to the manuscript in terms of design, data collection, analysis, and interpretation, and to drafting the manuscript; Joachim Saloga helped to prepare the manuscript and to interpret the data.

### Conflict of interest statement

Prof. Blettner received consultancy fees from the companies Astra Zeneca and Astellas. Dr. Wigand, Prof. Saloga, und Prof. Decker declare no conflicts of interest.

Manuscript received on 24 January 2012, revised version accepted on 23 April 2012.

Translated from the original German by Veronica A. Raker, PhD.

### REFERENCES

- Brien S, Ronksley PE, Turner BJ, Mukamal KJ, Ghali W: Effect of alcohol consumption on biological markers associated with risk of coronary heart disease: systematic review and meta-analysis of interventional studies. *BMJ* 2011; 342: d636.

### KEY MESSAGES

- In a cross-sectional study, about 7% of all people in a wine growing town (Mainz) reported intolerance or allergy-like symptoms after drinking wine, and especially after red wine.
- Wine intolerance, as diagnosed based on participant responses, is more common in women than in men.
- Wine intolerance occurs at a comparable frequency to other common food intolerances, yet it has been widely ignored in the investigation of intolerance reactions.
- People with a wine intolerance reported more frequently having a beer and/or general alcohol intolerance.
- The fact that wine and alcohol intolerance exist should be borne in mind when evaluating food intolerances.

- Pozo-Bayon M, Monagas M, Bartolome B, Moreno-Arribas MV: Wine features related to safety and consumer health: an integrated perspective. *Critical reviews in food science and nutrition* 2012; 52: 31–54.
- Schutze M, Boeing H, Pischon T, et al.: Alcohol-attributable burden of incidence of cancer in eight European countries based on results from prospective cohort study. *BMJ* 2011; 342: d1584.
- Clayton DE, Busse W: Anaphylaxis to wine. *Clin Allergy* 1980; 10: 341–3.
- Vaswani SK, Chang BW, Carey RN, Hamilton RG: Adult onset grape hypersensitivity causing life threatening anaphylaxis. *Ann Allergy Asthma Immunol* 1999; 83: 25–6.
- Pastorello EA, Farioli L, Pravettoni V, et al.: Identification of grape and wine allergens as an endochitinase 4, a lipid-transfer protein, and a thaumatin. *J Allergy Clin Immunol* 2003; 111: 350–9.
- Kalogeromitros D, Rigopoulos D, Gregoriou S, et al.: Asymptomatic sensitisation to grapes in a sample of workers in the wine industry. *Occup Environ Med* 2004; 61: 709–11.
- Schäd SG, Trcka J, Vieths S, et al.: Wine anaphylaxis in a German patient: IgE-mediated allergy against a lipid transfer protein of grapes *Int Arch Allergy Immunol* 2005; 136: 159–64.
- Kalogeromitros DC, Makris MP, Gregoriou SG, Katoulis AC, Straurianeas NG: Sensitization to other foods in subjects with reported allergy to grapes. *Allergy Asthma Proc* 2006; 27: 68–71.
- Vassilopoulou EAJ, Tassios I, Rigby N, et al.: Severe Reactions to Grape, As Part of a Lipid Transfer Protein-Associated Clinical Syndrome. *Allergy* 2006; 117: S301.
- International Union of Immunological Societies (IUIS): Allergen Nomenclature Sub-Committee; [www.allergen.org](http://www.allergen.org); (last accessed 15 April 2012)
- Schäfer T, Bohler E, Ruhdorfer S, et al.: Epidemiology of food allergy/food intolerance in adults: associations with other manifestations of atopy. *Allergy* 2001; 56: 1172–9.
- Young E, Stoneham MD, Petrukevitch A, Barton J, Rona R: A population study of food intolerance. *Lancet* 1994; 343: 1127–30.
- Madsen C: Prevalence of food allergy: an overview. *Proc Nutr Soc* 2005; 64: 413–7.
- Burbach GJ, Heinerling LM, Zuberbier T: Sensibilisierungen gegenüber inhalativen Allergenen in Europa: Ergebnisse der GA2LEN Pricktest-Studien. *Allergologie* 2012; 35: 103–9.
- Hermann-Kunz E: Allergische Erkrankungen in Deutschland. *Bundesgesundheitsbl – Gesundheitsforsch – Gesundheitsschutz* 2000; 43: 400–6.

17. Okuda T, Fukui M, Takayanagi T, Yokotsuka K: Characterization of Major Stable Proteins in Chardonnay Wine. *Food Science Technol Res* 2006; 12: 131–6.
18. Kwon SW: Profiling of soluble proteins in wine by nano-high-performance liquid chromatography/tandem mass spectrometry. *J Agric Food Chem* 2004; 52: 7258–63.
19. Wigand P, Tenzer S, Schild H, Decker H: Protein composition of Red Wine in comparison with Rosé Wine and White Wine by Electrophoresis and HPLC/Mass Spectrometry. *J Agric Food Chem* 2009; 57: 4328–33.
20. Schäd SG, Trcha J, Lauer I, Scheurer S, Trautmann A: Wine allergy in a wine-growing district: tolerance induction in a patient with allergy to grape lipid transfer protein. *World Allergy Organization Journal* 2010; 3: 1–5.
21. Jansen SC, van Dusseldorp M, Bottema KC, Dubois AE: Intolerance to dietary biogenic amines: a review. *Ann Allergy Asthma Immunol* 2003; 91: 233–40.
22. Maintz L, Novak N: Histamine and histamine intolerance. *Am J Clin Nutr* 2007; 85: 1185–96.
23. Kaschak E, Göhring N, König H, Pfeiffer P: Biogene Amine in deutschen Weinen: Analyse und Bewertung nach Anwendung verschiedener HPLC-Verfahren. *Dtsch Lebensmittelrundscha* 2009; 105: 375–82.
24. Vally H, de Klerk N, Thompson PJ: Alcoholic drinks: important triggers for asthma. *J Allergy Clin Immunol* 2000; 105: 462–7.
25. Linneberg A, Nielsen NH, Madsen F, Frolund L, Dirksen A, Jørgensen T: Factors related to allergic sensitization to aeroallergens in a cross-sectional study in adults: The Copenhagen Allergy Study. *Clin Exp Allergy* 2001; 31: 1409–17.
26. Zuberbier T, Edenharter G, Worm M, et al.: Prevalence of adverse reactions to food in Germany – a population study. *Allergy* 2004; 59: 338–45.

---

**Corresponding author**

Prof. Dr. rer. nat. Heinz Decker  
 Institut für Molekulare Biophysik  
 Johannes Gutenberg-Universität Mainz  
 Jakob-Welder-Weg 26, 55128 Mainz, Germany  
 hdecker@uni-mainz.de