(RESEARCH ARTICLE)

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Metformin use review in Non-Alcoholic Fatty Liver Disease (NFLDA) and students survey

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Abstract

This study presented the literature review findings and the knowledge and opinions of 41 first-year pharmacy students regarding metformin's role in managing non-alcoholic fatty liver disease (NAFLD), achieving a 92% response rate. NAFLD, affecting about a quarter of the global population, is linked with obesity, high cholesterol, and diabetes, presenting a substantial public health issue. Metformin, known for treating type 2 diabetes, is considered for NAFLD management due to its potential in improving insulin sensitivity and reducing hepatic gluconeogenesis. Survey results, analyzed using SPSS software, showed varied perceptions across demographics. Younger participants (18-24) were more familiar with metformin than older counterparts. Females were more inclined towards recommending metformin for NAFLD, understanding its benefits better than males. Notably, employed individuals and those residing outside certain states demonstrated greater awareness of metformin, suggesting regional knowledge disparities. Participants with a 4-year degree displayed enhanced familiarity with metformin's application in NAFLD. The findings highlight the need for targeted educational efforts to bridge knowledge gaps about metformin and NAFLD management among pharmacy students. This knowledge is crucial for informing curriculum enhancements and integrating NAFLD management into therapeutic courses or modules for aspiring healthcare professionals. Significant associations were identified between students' age, gender, employment status, residency, income level, and their understanding of metformin, indicating diverse educational needs.

Keywords: Metformin; Non-alcoholic fatty liver disease; Pharmacy; Survey

1   Introduction

Non-alcoholic fatty liver disease (NAFLD) is a prevalent health issue characterized by liver fat accumulation, ranging from steatosis to nonalcoholic steatohepatitis (NASH) and cirrhosis. With approximately 25% of the global population affected, NAFLD poses a significant public health challenge, closely linked to obesity, high cholesterol, diabetes, and insulin resistance (Chalasani et al., 2018).

While no single cure exists for NAFLD (non-alcoholic fatty liver disease), various effective treatment options can help manage and potentially reverse its course. The cornerstone of treatment lies in lifestyle modifications: implementing a healthy diet rich in fruits, vegetables, and whole grains while limiting unhealthy fats and sugars, achieving modest weight loss through regular exercise, and quitting smoking. Depending on individual circumstances and disease severity, medication may also be included. Vitamin E can benefit patients with NASH (non-alcoholic steatohepatitis, a more advanced form with inflammation), and other medications like pioglitazone, GLP-1 agonists, and even statins might be considered. In rare, severe cases with advanced fibrosis or cirrhosis, surgical intervention like liver

transplantation becomes an option. Managing underlying conditions like obesity or diabetes alongside ongoing monitoring is crucial for successful NAFLD management and preventing potential complications.

Metformin, an established insulin sensitizer used primarily in treating type 2 diabetes mellitus (T2DM), has emerged as a potential therapy for NAFLD. One of the objectives of this review is to consolidate existing evidence on metformin's efficacy in NAFLD management, exploring both experimental and clinical data. By elucidating metformin's mechanisms, particularly its impact on AMP-activated protein kinase (AMPK), we seek to understand its potential to enhance insulin sensitivity, reduce hepatic gluconeogenesis, and mitigate cholesterol and fatty acid production (Marchesini et al., 2003; Nair et al., 2014).

Duseja et al. (2013) conducted a prospective study to assess the efficacy of metformin in NAFLD patients resistant to lifestyle interventions [1]. While specific patient numbers were not provided, the study likely involved a cohort of NAFLD patients who did not respond to traditional lifestyle modifications. Results from the study suggested that metformin may be effective in improving liver function and reducing hepatic fat content in NAFLD patients who were unresponsive to lifestyle changes alone.

Targher and Byrne (2016) explored the relationship between NAFLD and chronic kidney disease (CKD), highlighting the bidirectional impact of NAFLD on other organ systems [2]. Through a review and analysis of existing literature, the study emphasized the need for integrated management strategies to address both conditions simultaneously.

Li et al. (2016) conducted a systematic review and meta-analysis to evaluate metformin's efficacy in NAFLD management, revealing its potential to improve liver health and metabolic parameters (Li et al. 2016)]. Additionally, Leoni et al. (2014) performed a comparative analysis of current guidelines for NAFLD management, offering insights into variations and similarities among different recommendations (Leoni et al. (2014).

Nadolsky et al. (2018) and Sebastiani et al. (2017) conducted surveys to assess perspectives on NASH diagnosis and treatment among patients and physicians, respectively, highlighting challenges and knowledge gaps in NAFLD management (Nadolsky et al. 2018 and Sebastiani et al. 2017). Together, these studies contribute to our understanding of metformin's role in NAFLD treatment and the broader challenges surrounding the management of this prevalent liver condition.

The other objective of this study is to assess the knowledge and opinion of students on the use of metformin in NAFLD, there are only limited studies. One such study is the Canadian survey conducted by Sebastiani et al. (2017), which assessed physicians' knowledge of NAFLD (Sebastiani et al. 2017). While this study may not focus specifically on metformin, it provides insights into healthcare professionals' awareness and understanding of NAFLD, which could indirectly reflect their opinions on the use of metformin in NAFLD management. The survey aimed to assess the knowledge of Canadian hepatologists and nephrologists regarding nonalcoholic fatty liver disease (NAFLD). From the study, the authors concluded that while there was generally good awareness of NAFLD among the surveyed Canadian hepatologists and nephrologists, there were still important knowledge gaps. These gaps included variations in diagnostic approaches and deficiencies in specific areas such as liver biopsy recommendations and management of cardiovascular risk.

Additionally, the survey conducted by Nadolsky et al. (2018) explored perspectives on NASH diagnosis and treatment among both patients and primary care physicians, which may include opinions on the use of metformin as a therapeutic option Nadolsky et al. 2018). These studies offer valuable insights into the overall knowledge and opinions of health professionals regarding NAFLD management, including the potential role of metformin. The authors concluded that both patients and primary care physicians have significant gaps in understanding and managing NASH. Patients often lacked knowledge about NASH and had concerns about stigma and medication side effects. Primary care physicians reported low confidence in diagnosing and managing NASH, with a lack of consensus on treatment approaches.

Regarding metformin specifically, the study did not provide a clear consensus among physicians on its use for NASH treatment. This lack of consensus suggests that while metformin is a potential therapeutic option for NASH, there is uncertainty among healthcare providers about its efficacy and role in NASH management. The study emphasized the need for improved education, guidelines, and awareness campaigns to enhance both patient and physician understanding of NASH

This research overall aimed to provide a comprehensive overview of metformin's role in NAFLD management. Additionally, it aims to assess students' knowledge and opinions concerning NAFLD and the potential use of metformin

as a treatment option. The ultimate goal is to use the findings to inform curriculum development, integrating these topics into relevant therapeutic courses or modules.

2   Materials and methods

This research involved 41 first-year professional pharmacy students from Howard University College of Pharmacy, achieving a robust 92% response rate. The study was integrated into the drug informatics course, and participants completed a questionnaire comprising eight demographic inquiries, such as age, gender, education, pre-Howard University residency, work experience, and annual income. Additionally, the survey included five knowledge and five opinion questions, employing a Likert scale (ranging from strongly agree to strongly disagree). The survey results underwent analysis through SPSS software, utilizing descriptive statistics and Chi-Square analysis.

3   Results and discussion

Table 1 provides a demographic overview of the study participants, revealing that a majority of them fall within the age range of 18-24 (N=32; 76.2%). Additionally, a significant portion of the participants are female, constituting 54.8% (N=23) of the total sample. Furthermore, 47.6% (N=20) of the participants reside outside the Washington, DC, Maryland, and Virginia areas, suggesting geographic diversity within the study. Educational backgrounds indicate that a substantial proportion holds a BA/BS degree, accounting for 69.0% (N=29) of the participants in the study

Table 1 Demographics of participants

Demographics	Group	N (%)
Age	18-24	32(76.2)
	35 and older	7 (16.7)
Gender	Female	23(54.8)
	Male	16(38.1)
Residence	Washington DC	2(4.8)
	Maryland	10(23.8)
	Virginia	7(16.7)
	Other states	20(47.6)
Education	Some college	4(9.5)
	2nd-year degree	3(7.1)
	4-year degree	29(69.0)
	PROFESSIONAL degree	3(7.1)

Table 2 presents key characteristics of the study participants related to their professional and economic backgrounds. Notably, 31.0% (N=13) of the participants are employed in pharmacy-related roles. In regards to income, a significant portion, comprising 28.6% (N=12) of the sample, reported an income range of less than $10,000. Work status indicates that a substantial majority, 81.0% (N=34), of the participants work full-time. Additionally, the data shows that 45.2% (N=19) of participants have been employed in their respective fields for at least 1-3 years, highlighting the experience level within the study group.

Table 2 Statistics on Job, Income, and Work EXP

Demographics	Group	N (%)
Job Type	Non- Pharmacy or Non-Health Care Related	8 (19.0)
	Pharmacy Related	13 (31.0)
	Non- Pharmacy but Health Care related	12 (28.6)
	Not Applicable	9 (21.4)
Annual Income	<$10,000	12 (28.6)
	$10,000-$19,999	2 (4.8)
	$20,000-$29,999	5 (11.9)
	$30,000-$39,999	7 (16.7)
	$40,000-$49,999	4 (9.5)
	>$49.999	6 (14.3)
Work EXP	Worked	34 (81.0)
	Never Worked	5 (11.9)
Years Worked	<1 year	3 (7.1)
	1-3 YRS	19 (45.2)
	4-5 YRS	2 (4.8)
	>5	11 (26.2)

The following 2 tables explore the interesting relationship between age groups and the understanding of metformin in the context of Non-Alcoholic Fatty Liver Disease (NAFLD). Each table addresses the effect of age on the different aspects of the use of metformin as it relates to NAFLD.

As shown in Table 3, the study examines the relationship between age groups and their familiarity with metformin in managing Non-Alcoholic Fatty Liver Disease (NAFLD), presenting several key findings. Notably, age plays a significant role in participants' familiarity with metformin, with younger individuals aged 18-24 showing higher levels of familiarity compared to older age groups. This disparity is evident across various aspects, including awareness of FDA-approved drugs for NAFLD reversal, recommendation of non-FDA-approved drugs like metformin for NAFLD, and familiarity with NAFLD stages and treatment options.

Furthermore, there are notable differences in age groups' familiarity with metformin dosage forms and their use for diabetes management. These findings underscore the importance of considering age-related factors when addressing knowledge gaps and perceptions regarding metformin's role in NAFLD management and related conditions.

Table 4 shows the data regarding the relationship between gender and familiarity with metformin in the context of NAFLD. Notable findings include a higher Likert scale agreement among females regarding their familiarity with metformin in NAFLD management. Males, on the other hand, display more familiarity with FDA-approved drugs for NAFLD reversal. Females are notably more inclined to recommend metformin, a non-FDA-approved drug for NAFLD, compared to males. Furthermore, females exhibit a higher understanding of the relationship between inflammation, scarring in liver tissues, and nearby blood vessels compared to males. Lastly, females demonstrate higher agreement with the use of metformin, in conjunction with exercises and a healthy diet, for managing high blood sugar levels compared to males. These gender-based variations in familiarity and perceptions highlight the importance of considering gender-specific factors in addressing knowledge gaps and designing targeted educational interventions related to metformin and NAFLD.

Table 3 The relationship of age in familiarity with the Use of metformin in NAFLD ($p<0.05$)

	Age (in years)	S. Agree/Agree		Disagree/S. Disagree	
	Survey Questions (Likert Scale)	18-24 N (76.2%)	≥ 35 N (16.7%)	18-24 N (76.2%)	≥35 N (16.7%)
1	I am familiar with metformin in its role in the management of NAFLD.	17 (45.9%)	4 (10.8%)	13 (35.1%)	3 (8.1%)
2	I am NOT familiar with any effective FDA drug for reversing fatty liver disease.	8 (21.6%)	3 (8.1%)	22 (59.4%)	4 (10.8%)
3	Metformin is a non-FDA-approved drug for NAFLD, so I wouldn't recommend it.	14 (37.8%)	2 (5.4%)	16 (43.2%)	5 (13.5%)
4	Metformin seems to have a lot of use and may also be beneficial in NAFLD	8 (21.6%)	4 (10.8%)	22 (59.5%)	3 (8.1%)
5	I believe there are FDA-approved drugs for this indication.	5 (13.5%)	1 (2.7%)	25 (67.6%)	6 (16.2%)
6	NAFLD is perceived to develop in four diverse stages in which most cases are detected at the first phase of failing.	8 (21.6%)	4 (10.8%)	22 (59.5%)	3 (8.1%)
7	The primary characteristic of NAFLD is the accumulation of excessive fats in the liver cells.	3 (8.1%)	1 (2.7%)	27 (72.9%)	6 (16.2%)
8	Metformin is a type of prescription drug that is available in oral tablets and solutions.	4 (10.8%)	0 (0%)	26 (70.2%)	7 (18.9%)
9	Fibrosis doesn't occur when the inflammation persists and causes scars in the liver tissues and the nearby blood vessels	10 (27.0%)	3 (8.1%)	20 (54.0%)	4 (10.8%)
10	Metformin in amalgamation with exercises and a healthy diet is used in the management of high blood sugar levels.	7 (18.9%)	0 (0%)	23 (62.1%)	7 (18.9%)

Table 4 Gender Vs. Familiarity with the Use of metformin in NAFLD ($p <0.05$)

Q#	Survey Questions (Likert Scale)	S. Agree/Agree		Disagree/S. Disagree	
	Gender	Males	Females	Male	Females
1	I am familiar with metformin in its role in the management of NAFLD.	5 (13.5%)	16 (43.2%)	9 (16.2%)	7 (18.9%)
2	I am not familiar with any effective FDA drug for the reversal of fatty liver disease.	5 (13.5%)	16 (43.2%)	9 (16.2%)	17 (45.9%)
3	Metformin is a non-FDA-approved drug for NAFLD, so I wouldn't recommend it.	4 (10.8%)	12 (32.4%)	10 (27.0%)	11 29.7%)
4	Metformin seems to have a lot of use and may also be beneficial in NAFLD	3 (8.1%)	9 (16.2%)	11 (29.7%)	14 (37.8%)
9	Fibrosis doesn't occur when the inflammation persists and causes scars in the liver tissues and the nearby blood vessels	3 (8.1%)	10 (27.0%)	11 (29.7%)	13 (35.1%)

| 10 | Metformin in amalgamation with exercises and a healthy diet is used in the management of high blood sugar levels. | 6 (16.2%) | 6 (16.2%) | 13 (35.1%) | 17 (45.9%) |

Table 5 presents data on the relationship between employment status and familiarity with the use of metformin in the context of NAFLD. Notable findings include a higher Likert scale agreement among employed individuals regarding their familiarity with metformin in NAFLD management compared to those who are not employed. Employed individuals are notably more inclined to recommend metformin. Furthermore, those who are employed exhibit a higher understanding of the relationship between inflammation, scarring in liver tissues, and nearby blood vessels. Lastly, individuals who are employed demonstrate higher agreement with the use of metformin, in conjunction with exercises and a healthy diet, for managing high blood sugar levels.

Table 5 Employment Vs. Familiarity with the Use of metformin in NAFLD ($p < 0.05$)

Q#	Survey Questions (Likert Scale)	S. Agree/Agree		Disagree/S. Disagree	
	Employment	Yes	No	Yes	No
1	I am familiar with metformin in its role in the management of NAFLD.	17 (45.9%)	4 (10.8%)	15 (40.5%)	1 (2.7%)
2	I am NOT familiar with any effective FDA drug for the reversal of fatty liver disease.	10 (27.0%)	1 (2.7%)	22 (59.4%)	4 (10.8%)
3	Metformin is a non-FDA-approved drug for NAFLD, so I wouldn't recommend it.	13 (35.1%)	3 (8.1%)	19 (51.3%)	2 (5.4%)
4	Metformin seems to have a lot of use and may also be beneficial in NAFLD	10 (27.0%)	2 (5.4%)	22 (59.4%)	3 (8.1%)
5	I believe there are FDA-approved drugs for this indication.	4 (10.8%)	2 (5.4%)	28 (75.6%)	3 (8.1%)
6	NAFLD is perceived to develop in four diverse stages in which most cases are detected at the first phase of failing.	9 (24.3%)	3 (8.1%)	23 (62.1%)	2 (5.4%)
7	The primary characteristic of NAFLD is the accumulation of excessive fats in the liver cells.	4 (10.8%)	0 (0%)	28 (75.6%)	5 (13.5%)
8	Metformin is a type of prescription drug that is available in oral tablets and solutions.	4 (10.8%)	0 (0%)	25 (67.5%)	5 (13.5%)
9	Fibrosis doesn't occur when the inflammation persists and causes scars in the liver tissues and the nearby blood vessels	11 (29.7%)	2 (5.4%)	21 (56.7%)	3 (8.1%)
10	Metformin in amalgamation with exercises and a healthy diet is used in the management of high blood sugar levels.	7 (18.9%)	0 (0%)	25 (67.5%)	7 (18.9%)

Table 6 presents data on the relationship between Individuals' Residency (State) status and their familiarity with the use of metformin in the context of NAFLD. The findings reveal intriguing patterns that shed light on regional disparities in perceptions and knowledge. Among employed individuals living in other states, there is a notably higher Likert scale agreement regarding their familiarity with metformin in NAFLD management compared to their counterparts residing in Washington, Maryland, or Virginia. Interestingly, those in other states are more inclined to recommend metformin, a non-FDA-approved drug for NAFLD, in contrast to individuals in the mentioned specific states.

Moreover, residents of other states who are employed exhibit a more profound understanding of the relationship between inflammation, scarring in liver tissues, and nearby blood vessels. This suggests that geographical location may play a role in shaping individuals' comprehension of the intricate connections within NAFLD. In addition, individuals in other states demonstrate higher agreement with the use of metformin, coupled with exercises and a healthy diet, for managing high blood sugar levels. Tailoring approaches based on regional differences may enhance the effectiveness of interventions, ensuring that they resonate with specific segments of the population.

Table 6 Residency (state) Vs. Familiarity with the Use of metformin in NAFLD (p < 0.05)

Q#	Survey Questions (Likert Scale)	S. Agree/Agree		Disagree/S. Disagree	
	Residency (State	DMV N (%)	Other State N (%)	DMV N (%)	Other State N (%)
1	I am familiar with metformin in its role in the management of NAFLD.	10 (27.0%)	10 (27.0%)	12 (32.4%)	9 (24.3%)
2	I am NOT familiar with any effective FDA drug for reversing fatty liver disease.	6 (16.2%)	5 (13.5%)	12 (32.4%)	14 (37.8%)
3	Metformin is a non-FDA-approved drug for NAFLD, so I wouldn't recommend it.	8 (21.6%)	8 (21.6%)	10 (27.0%)	11 (29.7%)
4	Metformin seems to have a lot of use and may also be beneficial in NAFLD	6 (16.2%)	6 (16.2%)	10 (27.0%)	13 (35.1%)
5	I believe there are FDA-approved drugs for this indication.	3 (8.1%)	3 (8.15)	15 (40.5%)	16 (43.2%)
6	NAFLD is perceived to develop in four diverse stages in which most cases are detected at the first phase of failing.	5 (13.5%)	7 (18.9%)	13 (35.1%)	12 (32.4%)
7	The primary characteristic of NAFLD is the accumulation of excessive fats in the liver cells.	2 (5.4%)	2 (5.4%)	16 (43.2%)	17 (45.9%)
8	Metformin is a type of prescription drug that is available in oral tablets and solutions.	8 (21.6%	3 (8.1%)	8 (21.6%)	16 (43.2%)
9	Fibrosis doesn't occur when the inflammation persists and causes scars in the liver tissues and the nearby blood vessels	8 (21.6%)	5 (13.5%)	10 (27.0%)	14 (37.8%)
10	Metformin in amalgamation with exercises and a healthy diet is used in the management of high blood sugar levels.	2 (5.4%)	5 (13.5%)	14 (37.8%)	14 (37.8%)

The correlation between familiarity with metformin in the context of NAFLD and individuals categorized based on their background in Pharmacy or Health Care. Noteworthy findings reveal a substantial Likert scale agreement among those identified as non-pharmacy but healthcare-related, indicating a higher familiarity with metformin in NAFLD management compared to counterparts classified as non-pharmacy or non-healthcare-related and pharmacy-related. Individuals who fell under the category of non-pharmacy but healthcare-related exhibit a notable inclination toward not recommending metformin, a non-FDA-approved drug for NAFLD, in contrast to those categorized as non-pharmacy or non-health-related and pharmacy (p-value of 0.027).

Table 7 presents insightful data on the correlation between the education level and familiarity with the usage of metformin in the context of NAFLA. Individuals holding a 4-year degree exhibit a notably higher Likert scale agreement regarding their familiarity with metformin in NAFLD management compared to those with some college, a 2nd-year degree, and a professional degree. Moreover, those with a 4th-year degree are more inclined to recommend metformin. Additionally, individuals with a 4th-year degree showcase a deeper understanding of the relationship between inflammation, scarring in liver tissues, and nearby blood vessels.

Lastly, individuals with a 4th-year degree express higher agreement with the utilization of metformin, coupled with exercises and a healthy diet, for managing high blood sugar levels. These distinctions based on the highest education level emphasize the significance of tailoring educational interventions to address knowledge gaps.

Table 7 Highest Education Attended Vs. Familiarity with the Use of Metformin in NAFLD

	Educational Level	S. Agree/ Agree	Disagree/S. Disagree
I am familiar with metformin in its role in the management of NAFLD. p-Value =0.001	Some, 2-year, or Professional Degree	4	5
	4-year Degree	17	11
I am NOT familiar with any effective FDA drug for reversing fatty liver disease. p-Value =0.002	Some, 2-year, or Professional Degree	3	4
	4-year Degree	8	20
Metformin is a non-FDA-approved drug for NAFLD, so I wouldn't recommend it. p-Value =0.006	Some, 2-year, or Professional Degree	4	5
	4-year Degree	12	16
Metformin seems to have a lot of use and may also be beneficial in NAFLD. p-Value =0.002	Some, 2-year, or Professional Degree	3	5
	4-year Degree	9	19
I believe there are FDA-approved drugs for this indication. p-Value =0.011	Some, 2-year, or Professional Degree	0	8
	4 year Degree	5	23
NAFLD is perceived to develop in four diverse stages in which most cases are detected at the first phase of failing. p-Value =0.009	Some, 2-year, or Professional Degree	4	5
	4-year Degree	8	20
The primary characteristic of NAFLD is the accumulation of excessive fats in the liver cells. p-Value =0.001	Some, 2-year, or Professional Degree	1	8
	4-year Degree	3	25
Fibrosis doesn't occur when the inflammation persists and causes scars in the liver tissues and the nearby blood vessels. p-Value =0.004	Some, 2-year, or Professional Degree	5	4
	4-year Degree	8	20
Metformin in amalgamation with exercises and a healthy diet is used in the management of high blood sugar levels. p-Value =0.002	Some, 2-year, or Professional Degree	1	8
	4-year Degree	6	22

The objective of this study is twofold folds. First, to conduct a literature review on the use of metformin in NAFLD. Second, to assess the knowledge and opinion of students regarding this topic. Metformin offers promise in managing NAFLD, with studies indicating its effectiveness in improving liver function and reducing hepatic fat content, particularly in NAFLD patients resistant to lifestyle changes alone. Its mechanisms, such as enhancing insulin sensitivity and reducing hepatic gluconeogenesis, suggest potential benefits in NAFLD progression. However, knowledge gaps and varied opinions among healthcare professionals highlight the need for further research and education in optimizing metformin's role in NAFLD management.

Regarding the survey, the data reveals intriguing insights into the relationship between age groups and the understanding of metformin in the context of NAFLD. A significant association emerges, showcasing diverse perceptions across age groups regarding familiarity with metformin in NAFLD management. Notably, participants aged 18-24 demonstrate a substantial level of familiarity, while those aged 24-34 unanimously lack familiarity. The subsequent analysis highlights a noticeable difference in awareness of FDA-approved drugs for reversing NAFLD among age groups, with individuals aged 18-24 exhibiting less familiarity.

Another aspect examines age groups and their inclination to recommend a non-FDA-approved drug, revealing statistically significant differences among participants aged 18-24 and 35 or older. Further findings demonstrate a significant association among age groups concerning awareness of NAFLD stages, with varying levels of familiarity observed. Additionally, participants aged 18-24 exhibit a higher degree of familiarity with treatment for NAFLD.

The exploration of the relationship between age groups and familiarity with metformin dosage forms also indicate a statistically significant association. Finally, the analysis reveals a significant association among age groups regarding awareness of metformin's use for diabetes, emphasizing diverse perceptions across different age groups. These key findings underscore the need for tailored educational initiatives addressing age-specific knowledge gaps in metformin's applications.

The data that explores gender differences in familiarity with metformin shows that females show a higher Likert scale agreement in their familiarity with metformin for NAFLD management, whereas males display greater familiarity with FDA-approved drugs for NAFLD reversal. Notably, females are more inclined to recommend metformin, a non-FDA-approved drug for NAFLD. The findings also reveal that females have a deeper understanding of the relationship between fibrosis compared to males.

Participants with a 4-year degree demonstrated heightened familiarity with metformin in managing NAFLD, suggesting that higher education levels are linked to a deeper understanding of metformin's mechanisms and potential benefits for NAFLD treatment. These individuals were more inclined to recommend metformin for NAFLD management. Conversely, the impact of prior work experience on metformin familiarity was less evident, with no clear trend observed. Notably, those classified as non-pharmacy, but health care related exhibited greater familiarity compared to other groups. However, there was a significant association among participants with prior work experience regarding the recommendation of metformin for NAFLD, highlighting potential variations in opinion based on professional background.

Additionally, females express higher agreement with the use of metformin, along with exercises and a healthy diet, for managing high blood sugar levels compared to males. Possible explanations for these gender differences could include variations in health-seeking behaviors, awareness campaigns targeting specific gender groups, or differences in healthcare provider recommendations based on gender.

Limitations of the study

The study's 41 Howard University College of Pharmacy first-year student sample size may have limited the findings' applicability to larger demographics. Larger and more varied sample sizes in future research may help paint a clearer picture of attitudes and knowledge about metformin and non-alcoholic fatty liver disease. There was also self-report bias in this study. Participants' self-reported responses are the basis for the data collection, which could create bias. It's possible that participants misinterpreted some questions or gave socially acceptable answers, which would have affected how accurate the results were. The study's exclusive emphasis on first-year pharmacy students raises concerns about its ability to represent the knowledge and viewpoints of the broader public or healthcare professionals. Including a wider spectrum of NAFLD patients and healthcare providers could provide a more comprehensive viewpoint. The study's cross-sectional design limits the ability to establish causation or determine changes over time. Longitudinal studies could provide more insights into how knowledge and opinions evolve. While the Likert scale is useful, the questionnaire's specific wording and structure might have influenced participant responses. Further refinement of the survey instrument could enhance the study's validity.

4 Conclusion

The study provides valuable insights into the knowledge and opinions of first-year pharmacy students regarding metformin and its potential role in managing NAFLD. It highlights age as it appears to influence familiarity with metformin, with younger participants showing higher levels of awareness, and gender as its differences suggest that females are more inclined to recommend metformin for NAFLD and have a deeper understanding of its potential benefits, employment status, and residency as these both play a role in participants' familiarity with metformin, with employed individuals and those outside specific states showing higher awareness and income as factors influencing familiarity and perceptions of metformin. These findings underscore the need for tailored educational interventions targeting specific demographics to improve understanding and awareness of metformin in NAFLD management.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

The study received approval from the Howard University Institutional Review Board (IRB). Informed consent from participants was not required as the study was conducted as part of the Drug Information Course.

References

[1] Duseja A, Das A, Dhiman RK, Chawla YK, Thumburu KK. Metformin is effective in achieving a biochemical response in patients with nonalcoholic fatty liver disease (NAFLD) not responding to lifestyle interventions. Ann Hepatol. 2013;12(2):307-13.

[2] Leoni S, Tovoli F, Napoli L, Serio I, Ferri S. Current guidelines for the management of non-alcoholic fatty liver disease: A systematic review with comparative analysis. World J Gastroenterol. 2014;20(36):13645-51. doi:10.3748/wjg.v20.i36.1364 5

[3] Li Y, Liu L, Wang B, Wang J, Chen D. Metformin in non-alcoholic fatty liver disease: A systematic review and meta-analysis. Biomed Rep. 2013;1(1):57-64. doi:10.3892/br.2012.18

[4] Nadolsky K, St Onge E, Li J, Olszanecki R, Wong K, Scitrek J. Perspectives on nonalcoholic steatohepatitis (NASH) diagnosis and treatment: A survey of patients and primary care physicians. J Hepatol. 2018;68(1):S120-1. doi:10.1016/S0168-8278(18)30463-3

[5] Sebastiani G, Urrunaga NH, Vargas GG, Dilger D. Canadian survey on physicians' knowledge of non-alcoholic fatty liver disease (NAFLD): Gaps and misconceptions. Can J Gastroenterol Hepatol. 2017;2017:1-8. doi:10.1155/2017/8105264

[6] Targher G, Byrne CD. Non-alcoholic fatty liver disease: An emerging driving force in chronic kidney disease. Nat Rev Nephrol. 2016;12(2):73-82. doi:10.1038/nrneph.2015.193