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Lycopene for Hypertension and Factors Affecting Its Use: A Survey of Pharmacy Students

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ABSTRACT

Purpose
To better understand and assess the potential obstacles to the adoption of lycopene for treating high blood pressure.

Methods
A cross-sectional observational study was conducted by administering a survey to 42 Howard University College of Pharmacy students. Descriptive statistics and risk estimates were calculated using statistical package for social studies (SPSS) software.

Results
Only 33.3% of students had ever heard of lycopene, and lycopene knowledge score was poor among 88% of respondents. Non-D.C. residence, dietary supplement use and the belief that dietary supplements such as lycopene interact with prescription drugs and should be used cautiously, were all correlated with a lesser risk of having poor lycopene knowledge. Annual income >$40,000 was correlated with a greater risk of being in the poor lycopene knowledge group. Despite this data, 59.5% report that will incorporate more lycopene into their diet.

Conclusion
Lycopene knowledge is generally poor among the observed cohort; however, this does not seem to be a great obstacle in the path of adoption.

Keywords
Lycopene; Dietary supplement; Hypertension; Cardiovascular.

INTRODUCTION

Hypertension remains a leading risk factor for cardiovascular disease, estimated to affect over 40% of American adults.[1] Prescription drug therapies and dietary restrictions have been mainstays of therapy for those with hypertension however, there has been growing inquiry into the potential of food products and supplements to positively impact blood pressure. One such food product is lycopene, a phytochemical found in fruits and vegetables such as tomato, guava, grapefruit, carrot, and watermelon. Lycopene is a carotenoid antioxidant. By scavenging reactive oxygen species, it can mitigate cellular oxidative damage, which has been implicated in cardiovascular disease and inflammation. Research also suggests that lycopene may have a beneficial effect on several other pathologies including prostate and colorectal cancer, and diabetes, as well as having hepatoprotective and neuroprotective properties.[2]

Lycopene consumption has also been demonstrated to reduce systolic blood pressure. A double-blind placebo-controlled study investigating the effect of various daily doses of lycopene on blood pressure found that 15 mg and 30 mg lycopene treatment groups experienced a statistically significant reduction in mean systolic blood pressure after 8 weeks (-9.8 mmHg/-7 mmHg respectively; $p<0.01$).[3] A meta-analysis investigating the effect of lycopene supplementation on blood pressure using the pooled data from six studies also found that lycopene produced a statistically significant reduction in systolic blood pressure and suggests that >12 mg daily intake of lycopene may produce greater blood pressure reduction than lower doses.[4] While no explicit recommendation regarding lycopene intake is given, these studies suggest, an intake of approximately 15 mg of lycopene daily may have a beneficial effect on blood pressure. In addition, lycopene is not

known to have significant drug-drug interactions or adverse effects, although some sources caution against taking lycopene in the weeks leading up to a surgery due to lycopene's antiplatelet effect, which is comparable to that of aspirin 81 mg.[5] There does not seem to be a consensus on the effect of lycopene supplementation in pregnant women. One study suggests that pregnant women avoid lycopene supplements due to an increased risk of premature birth and low birth weight,[6] while another suggests significantly improved perinatal outcomes in lycopene supplemented mothers.[7] In addition to this, it should be noted that no study that examines the effects of lycopene intake in pediatric populations exists. Despite these warnings, lycopene has consistently been found to have a favorable toxicity profile, even in cases of excessive ingestion.

It is thought that Lycopene's anti-hypertensive effect is due its ability to mitigate oxidative damage to vascular endothelial cells and to promote the expression of endothelial nitric oxide synthase. Due to this antihypertensive effect, lycopene supplementation may hold use as an adjunct to mainstay therapy or as a non-prescription option for those with mildly elevated blood pressure. In the current body of literature, data specifically concerning the public knowledge and attitudes towards lycopene are scarce. To better understand obstacles to the adoption of lycopene use in this capacity, and to understand the demographic factors that affect the attitudes towards its use and lycopene knowledge, survey data was collected from Howard University College of Pharmacy students and analyzed.

METHODS

A survey was administered to 42 students attending Howard University College of Pharmacy. The survey questions were designed to collect information on demographics, personal lifestyle, opinions, and lycopene knowledge. All question responses were categorical in nature. Cross-tabulation was facilitated by recoding responses into two categories for each question. Descriptive statistics and relative risks were calculated using the statistical package for social studies (SPSS) software, version 28.0.1.0 (142). For relative risks, a 95% confidence interval that excluded 1 was considered statistically significant.

RESULTS

Demographics and Work Experience

The demographic and work experience data shows that 73.5% of survey respondents were under the age of 26, and more than two-thirds were female. Of those surveyed, 81% report having earned a bachelor of arts (BA) or bachelor of science (BSc). The proportion of respondents that reside outside of D.C., Maryland or Virginia (DMV) is 42.9%, while 31% reside in the DMV. The proportion of respondents that have worked either a full-time or part-time job is 88%. Two-thirds of respondents have worked in medical prescription (Rx) related or other healthcare jobs. The proportion of respondents that have worked for at least 1-year is 97.6%. The proportion of respondents that report having worked either part-time or full-time jobs is 88.1%, and 21.4% report that they are currently working. Lastly, 73.9% of respondents report an annual income of less than $40,000 (Table 1).

Table 1: *Frequency Table of Lycopene Survey Respondent Demographics (n=42)*

		N (%)
Patient's age (in years)	21-23	14 (33%)
	24-26	17 (40.5%)
	27-29	5 (11.9%)
	>29	6 (14.3%)
Gender	Male	15 (35.7%)
	Female	27 (64.3%)
Highest education attained	Some college	1 (2.4%)
	Associate degree	1 (2.4 %)
	BA/BSC	34 (81%)
	MSC/MA	4 (9.5%)
	PHD/Professional	2 (4.8%)
Place of residence	Washington D.C.	4 (9.5%)
	Maryland	13 (31%)
	Virginia	16 (16.7%)
	Other states	18 (42.9%)

Opinion-Based Survey Questions

Respondents were asked to rank their agreement with the above opinion-based survey questions on a 4-point scale (strongly agree/agree/disagree/strongly disagree). The responses to each question were then grouped into those who agreed and those who disagreed.

Table 2: *Frequency Table of Lycopene Survey Respondent Income and Work Experience (n=42)*

		N (%)
Work experience	Never worked	2 (4.8%)
	Short term	3 (7.1%)
	Part-time	16 (38.1%)
	Full-time	21 (50%)
Type of job worked	RX related	16 (38.1%)
	Other healthcare	12 (28.6%)
	Non-healthcare	13 (31%)
	Not applicable	1 (2.4%)
Annual income	<10,000	13 (31%)
	$10,001-$20,000	7 (16.7%)
	$20,001-$30,000	6 (14.3%)
	$30,001-$40,000	5 (11.9%)
	>$40,000	11 26.2%)
Years worked	Never worked	1 (2.4%)
	1-2-years	19 (45.2%)
	3-4-years	11 (26.2%)
	>4-years	11 (26.2 5%)
Currently working	Yes	9 (21.4%)
	No, But plan to soon	18 (42.9%)
	No, no plan to work	15 (35.7%)

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Question 1 asks respondents to evaluate their own knowledge on dietary supplements. The proportion of respondents that claim to be comfortable in their dietary supplement knowledge is 59.5%, however, a still substantial proportion report not feeling comfortable. Question 2 asks respondents about their history interacting with patients as it relates to dietary supplements, and 66.6% of respondents report disagreement with this question. Question 3 asks respondents if they are currently taking dietary supplements, which saw an even split between agreement and disagreement. Question 4 asked if respondents had taken dietary supplements in the past, to which 69% indicated agreement. Question 5 asks if respondents are concerned about lycopene and potential drug interactions. Respondents overwhelmingly believe that lycopene interacts with prescription drugs, with 92.9% indicating agreement. Question 6 simply poll's respondents as to whether they have ever heard about lycopene, to which 33.3% report agreeing. Question 7 asks if respondents are comfortable with recommending lycopene and if it and other natural substances should be first line therapy for treating mild hypertension (HTN). The proportion of respondents that disagree with this statement is 59.5%, while a substantial minority agree. Finally, question 8 asks respondents whether they now personally have the intention of increasing their dietary lycopene intake for health purposes, to which 59.5% agreed and a substantial minority disagreed (Table 2).

Lycopene Knowledge Score

Respondents' lycopene knowledge score was measured by recording their responses to a series of three statements. Each respondent was awarded a score of 0-3 for each question depending on their level of agreement with each correct statement. The total lycopene knowledge score was the sum of the scores for each statement. The frequency table for each total score is recorded above. Thereafter, respondents were categorized into poor or good lycopene knowledge groups based on their total scores. If a respondent scored 6 or less, then they were placed in the poor knowledge group, and if they scored 7 or higher, then they were placed in the good knowledge group. Results show that 88% of respondents have poor lycopene knowledge (Table 3).

Risk Estimate

The relative risk of respondents being in the poor lycopene knowledge group between demographic categories and survey questions was calculated, along with the 95% confidence interval of the relative risk. Between all the demographic factors and survey responses collected, four were found to have statistically significant relative risks. The first of these significant relative risks is the relative risk of being in the poor lycopene knowledge category in the non-D.C. resident group compared to the D.C. resident group, and the relative risk was found to be 0.87. Next, the relative risk of being in the poor lycopene knowledge group in the >$40,000 income level compared to the <$40,000 income level was found to be 1.19. The relative risk of being in the poor lycopene knowledge group if a respondent agrees with the statement "*I am currently on some type of dietary supplements including vitamins*" compared to if they disagree with the statement was found to be 0.81. Finally, the relative risk of being in the poor lycopene knowledge group if a respondent agrees with the statement "*I believe dietary supplements such as lycopene interact with prescription medicines and should be used cautiously*". Compared to those who disagreed with the statement was found to be 0.87 (Table 4).

DISCUSSION

Although respondents report feeling confident about their dietary supplement knowledge, and report taking dietary supplements, their lycopene knowledge remained low. This mismatch between self-reported confidence and lycopene knowledge may be explained from two possible angles. It may be that the respondents

Table 3: *Frequency Table of Lycopene Survey Question Responses (n=42)*

Survey Questions	Strongly Agree/Agree	Disagree/Strongly Disagree
1. I am Comfortable in my knowledge of dietary supplements	25 (59.5%)	17 (40.5%)
2. I have been involved in counseling or interacting with patients discussing dietary supplements	14 (33.3%)	28 (66.6%)
3. I am currently on some type of dietary supplements including vitamins	21 (50.0%)	21 (50%)
4. I have taken dietary supplements in the past for various reasons	29 (69.0%)	13 (38.1%)
5. I believe dietary supplements such as lycopene interact with prescription medicines and should be used cautiously	39 (92.9%)	3 (7.1%)
6. I have heard about lycopene before	14 (33.3%)	28 (66.7%)
7. I feel comfortable recommending lycopene for a patient with HTN. Natural substances such as lycopene should be the first line in treating mild HTN	17 (40.5%)	25 (59.5%)
8. I will now start eating more foods containing lycopene for my own personal health	25 (59.5%)	17 (40.4%)

Table 4: Lycopene Knowledge Scores

1	2	3	4	5	6	7	8	9
1 (2.4%)	1 (2.4%)	3 (7.1%)	5 (11.9%)	13 (31%)	14(33.3%)	3 (7.1%)	0 (0%)	2 (4.8%)
Poor knowledge (≤70%)	Good knowledge (≥70%)							
37 (88%)	5 (11.9%)							

are legitimately knowledgeable about dietary supplements generally, but that lycopene is too obscure, and so they have not been exposed to research about its potential benefits. This hypothesis is supported by the fact that 66.6% of respondents disagreed that they had heard about lycopene before. Another explanation may be that the self-reported dietary supplement knowledge is inaccurate, and that respondents are not as knowledgeable as they believe themselves to be. This possibility would be congruent with findings from other studies that tested general dietary supplement knowledge. A study conducted by Alqrache et al[8] found that the student body of the Abdulaziz University in Saudi Arabia had low dietary supplement knowledge. Another peculiar finding was that 50% of respondents report currently taking dietary supplements, despite the young age of the cohort. This figure is similar to another study conducted by Samreen et al[9] at King Saud University College of Pharmacy, which found that 46.8% of pharmacy students used dietary supplements. Alqrache et al[8] also found that half of the male students who reported taking dietary supplements did so to improve body image and muscle bulk. It may be that young male cohorts have different motivations for taking dietary supplements, preferring to use them for body-image purposes rather than health reasons.

Several factors were found to have a statistically significant effect on lycopene knowledge. Firstly, non-D.C. residents were found to have a 13.2% lesser risk of being in the poor lycopene knowledge group compared to D.C. Residents. This indicates that lycopene knowledge is poorer among D.C. residents than residents of other localities.

Those with an annual income of >$40,000 were found to have 19.2% greater risk of being in the poor lycopene knowledge group compared to those with <$40,000 income. This result at first seems to be counter intuitive, however it may be that those with lower income tend to be more interested in natural products and other products that could be seen as over the counter (OTC) health promoting and disease preventing measures.

Respondents who agreed with the statement "*I am currently on some type of dietary supplement including vitamins*" had a 19% lesser risk of being in the poor lycopene knowledge group. This is not a surprising result, as it is likely that those who takes supplements may be more aware of the landscape of different natural health products and may have had more exposure to information about lycopene.

Respondents who agreed with the statement "*I believe that dietary supplements such as lycopene interact with prescription medications and should be used cautiously*" had a 12.9% lesser risk of being in the poor lycopene knowledge group. This type of caution with regards to anticipating drug interactions may be an artifact of pharmacy school education, which may prime students to expect an interaction. There are indeed many examples of dietary supplements that interact with prescription medications, and so agreement with this statement may indicate a higher level of general knowledge about lycopene and dietary supplements more broadly.

Lastly, an important finding is that, despite the previously mentioned poor lycopene knowledge among respondents, 59.5% of respondents report that they will consume more lycopene containing foods to promote their own personal health. It therefore seems that poor knowledge was not and overwhelming obstacle to respondents' willingness to use lycopene.

If the effects of lycopene on blood pressure revealed by the works of Wolak et al[3] and Li et al[4] are considered, then the potential for public benefit by its supplementation cannot be overstated. While previous studies by Algrache et al[8] and Samreen et al[9] have assessed demographic factors surrounding general dietary supplement use and attitudes, data specifically about lycopene, particularly in an American context, have not been collected. This present study narrows its focus and demonstrates the lack of lycopene knowledge among pharmacy students, and in doing so reveals possible obstacles to the public benefit that could be offered by the adoption of lycopene supplementation.

CONCLUSION

While lycopene knowledge is generally poor, most respondents report willingness to increase their dietary intake of lycopene. Educating health students and the public may be prudent to improve their receptivity to this promising natural antihypertensive agent. More studies with greater reach must be conducted to learn how to achieve this goal more efficiently.

LIMITATIONS

The limitations of this study include its relatively low sample size, the demographic skew of its respondents towards young people and females, and the fact that all respondents were pharmacy students at a single university. These factors damage the external validity of study results, as they may not be representative of the general population of interest.

INSTITUTIONAL REVIEW BOARD

This study has been approved by the Howard University (HU) Institutional Review Board (IRB).

CONSENT

Obtained.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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