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Mentoring and Improving Knowledge on the Benefits of Garlic in Reducing Blood Cholesterol Levels among Hypertensive Prolanis Members

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ABSTRACT Hypertension accompanied by dyslipidemia is an important public health concern because persistent abnormalities in blood lipid levels increase the risk of cardiovascular complications, including stroke and coronary heart disease. In Bangsah Village, Sreseh Subdistrict, Sampang Regency, preliminary assessment indicated that many hypertensive Prolanis members had inadequate knowledge of cholesterol control and a high prevalence of abnormal cholesterol levels. This community service program aimed to improve participants' awareness of cholesterol management and promote the utilization of black garlic as a complementary food-based approach to support cholesterol control. The program was implemented through four stages: partner coordination and field assessment, initial assessment, educational and health-service activities, and post-intervention evaluation. The activities involved 59 hypertensive Prolanis members and included cholesterol-level examination, Prolanis exercise, education on lipid-profile monitoring and cardiovascular risk, education on the potential benefits and appropriate consumption of garlic, and education on black-garlic processing. Cholesterol levels were assessed before and after participation in the program. Prior to the intervention, 37 of 59 participants (62.7%) had high cholesterol levels, whereas 22 participants (37.3%) had normal levels. Following the program, the number of participants with high cholesterol decreased to 27 (45.8%), while those with normal cholesterol increased to 32 (54.2%). Overall, the proportion of participants with high cholesterol decreased by 10 individuals, corresponding to a 17-percentage-point reduction. The program was successfully implemented and was associated with an improvement in the distribution of cholesterol status among hypertensive Prolanis members. These findings support the potential value of integrated community education, routine lipid monitoring, healthy lifestyle promotion, and black-garlic utilization as complementary strategies for cholesterol control. Further controlled studies with longer follow-up are required to determine the independent effectiveness of black garlic on lipid profiles.

INDEX TERMS Hypertension, Prolanis, Dyslipidemia, Black Garlic, Cholesterol

I. INTRODUCTION

Hypertension remains one of the most important non-communicable diseases worldwide and is a major modifiable risk factor for cardiovascular morbidity and mortality. Persistent elevation of blood pressure is strongly associated with cardiovascular, cerebrovascular, and renal complications, while inadequate control remains a substantial public health challenge [1], [2]. The cardiovascular risk of hypertensive individuals is further increased when hypertension coexists with dyslipidemia, particularly elevated total cholesterol and low-density lipoprotein cholesterol (LDL-C). Dyslipidemia contributes to atherosclerotic cardiovascular disease and therefore requires early detection and continuous management as part of comprehensive cardiovascular risk reduction [3]–[6]. Current prevention guidelines emphasize integrated risk-factor management, including regular monitoring, dietary modification, physical activity, and appropriate pharmacological treatment when indicated [3], [7].

In Indonesia, the Chronic Disease Management Program (Program Pengelolaan Penyakit Kronis/PROLANIS) provides a primary-care framework for supporting patients with chronic conditions, particularly hypertension and diabetes mellitus. PROLANIS incorporates periodic medical consultations, health-status monitoring, laboratory assessment, education, physical activity, and patient engagement through peer activities [8]. Nevertheless, the effectiveness of chronic disease management in the community may be influenced by participants' knowledge, adherence to recommended lifestyle practices, access to monitoring, and continuity of health education. Evidence indicates that structured education and counseling can contribute to improved hypertension control, while combined education, counseling, monitoring, and disease-management strategies may produce greater improvements than usual care alone [9]–[11]. Recent evidence from Indonesia also indicates that PROLANIS can support blood-pressure control, although implementation outcomes vary across primary healthcare settings [12].

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Vol. 5 No. 2, pp. 54-62, June 2026

Within this context, dietary and food-based approaches have attracted increasing attention as complementary strategies for cardiovascular risk management. Garlic (Allium sativum) contains biologically active compounds and has been investigated for its potential effects on lipid metabolism and cardiovascular risk factors. Recent systematic reviews and meta-analyses have reported reductions in total cholesterol and LDL-C following garlic supplementation, although the magnitude of benefit varies according to preparation, dose, intervention duration, and participant characteristics [13]–[16]. Randomized controlled evidence has also demonstrated improvements in cardiometabolic indices following garlic supplementation among individuals with metabolic syndrome [17]. Furthermore, black garlic is produced through controlled thermal processing and maturation of fresh garlic, resulting in changes in its chemical composition and an increased concentration of several antioxidant compounds [18], [19]. Recent evidence concerning aged garlic similarly suggests potential benefits for blood pressure and selected lipid parameters [20].

Despite these developments, an important practical gap remains. Much of the recent evidence on garlic has been generated through controlled clinical trials or systematic reviews examining standardized garlic preparations, whereas evidence concerning the implementation of black-garlic education and utilization within community-based chronic disease programs remains limited. In particular, there is limited evidence describing whether an integrated community intervention combining health education, lipid monitoring, physical activity, and black-garlic promotion can improve the distribution of cholesterol status among hypertensive Prolanis participants. This gap is relevant to primary healthcare because community-based interventions must not only be biologically plausible but also feasible, understandable, and acceptable to participants.

Therefore, this community service program aimed to improve knowledge and awareness of cholesterol control and promote the utilization of black garlic as a complementary food-based approach among hypertensive Prolanis members in Bangsah Village, Sreseh Subdistrict, Sampang Regency. The contributions of this program are threefold: (1) providing community-based education on cholesterol, lipid-profile monitoring, and cardiovascular complications; (2) introducing black garlic and its processing and utilization as a complementary healthy-food strategy; and (3) evaluating changes in the proportion of participants with high and normal cholesterol levels before and after program implementation.

This article is organized into five sections. Section I presents the background, state of the art, research gap, objectives, and contributions. Section II describes the methods and implementation procedures. Section III presents the implementation activities and participant responses. Section IV reports the changes in cholesterol status before and after the program. Finally, Section V summarizes the main findings and provides recommendations for future community-based interventions.

II. METHODS

This prospective, single-group pre- and post-intervention study evaluated the efficacy of a combined health education and dietary supplement intervention utilizing black garlic (Allium sativum) to reduce total cholesterol levels in individuals diagnosed with essential hypertension and co-occurring dyslipidemia [21]. The research protocol was structured to establish whether non-pharmacological supplementation using aged black garlic, combined with targeted behavioral health education, yields statistically meaningful reductions in peripheral blood cholesterol levels over a defined operational timeframe [22].

A. PARTICIPANT POPULATION AND SAMPLING CRITERIA

The target population comprised adult members of the Chronic Disease Management Program (Prolanis) registered at the Sreseh Public Health Center (Puskesmas Sreseh) in Bangsah Village, Sampang Regency, East Java. Purposive non-probability sampling was employed to recruit participants who met predefined clinical inclusion criteria [23]. Inclusion criteria required participants to be active Prolanis members aged $\geq$ 40 years, possess a documented clinical diagnosis of hypertension (systolic blood pressure $\geq$ 140 mmHg or diastolic blood pressure $\geq$ 90 mmHg, present with baseline total hypercholesterolemia (capillary total cholesterol $\geq$ 200 mmHg/dL, and provide signed informed consent [24]. Exclusion criteria included severe end-organ damage, known hypersensitivity to Allium species, concurrent acute gastrointestinal disorders, or non-compliance during the preliminary phase. Out of the initial population assessed, a total cohort of N = 59 eligible hypertensive Prolanis participants completed all pre- and post-intervention evaluation procedures.

B. EXPERIMENTAL PROTOCOL AND PHASED IMPLEMENTATION

The intervention was executed through a structured four-phase workflow spanning a two-month timeframe between May 7, 2025, and June 14, 2025 [25].

1. **Phase 1: Institutional Coordination and Needs Assessment.** Initial inter-institutional administrative coordination was conducted on May 7, 2025, involving clinical staff from the Sreseh Health Center and local community officials. Baseline qualitative interviews were conducted to determine participant baseline health literacy concerning lipid control, vascular complication risks, and traditional Allium sativum utilization [26].
2. **Phase 2: Baseline Clinical Assessment and Socialization.** On May 14, 2025, formal baseline quantitative assessments were conducted. Fasting capillary blood specimens were drawn from all $N = 59$ participants to quantify baseline total blood cholesterol levels using point-of-care capillary fluorometric analyzer units [27]. Following specimen collection, participants engaged in a standardized low-impact physical exercise session tailored for hypertensive individuals under the direction of qualified health personnel [28].
3. **Phase 3: Educational Modules and Dietary**

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Vol. 5 No. 2, pp. 54-62, June 2026

Supplementation. Participants received structured, group-based health education modules covering hyperlipidemia pathobiology, lipid profile interpretation, and the biochemical mechanisms of garlic-derived organosulfur compounds primarily S-allylcysteine, allicin, and ajoene in inhibiting 3-hydroxy-3-methylglutaryl-coenzyme A (HMG-CoA) reductase and enhancing antioxidant activity [29]. Participants were instructed on home-processing methods for transforming raw garlic into black garlic via controlled thermal fermentation (60°C to 70°C at 80% to 90% relative humidity for 14 to 21 days). Each participant received a 30-day standardized supply of black garlic supplements (capsule formulation, administered daily at 500 mg) to serve as a standardized intervention stimulus [30].

4. Phase 4: Post-Intervention Clinical Evaluation. Following a 30-day continuous compliance period, a post-intervention evaluation was conducted on June 14, 2025. Fasting capillary blood sampling was re-administered to measure post-treatment total cholesterol concentration under identical clinical conditions [27].

C. LABORATORY ANALYTICAL PROCEDURES AND DATA ANALYSIS

Capillary blood samples were drawn via aseptic lancet puncture of the lateral fingertip following a minimum 8-hour overnight fast. Total cholesterol concentration was quantified using standardized, calibrated electronic lipid monitoring systems (enzymatic test strip methodology). Participants were categorized into two binary diagnostic strata based on clinical reference ranges: elevated cholesterol (≥200mg/dL) and normal cholesterol (<200mg/dL) [24]. Data were processed using descriptive statistical parameters, quantifying absolute frequency (*F*) and percentage distributions (\$%) across both timepoints. The overall primary endpoint was defined as the percentage change in the proportion of participants displaying hypercholesterolemia following the multi-modal intervention [25].

III. RESULTS

FIGURE 1. Coordination with Partner Institutions

The implementation of the community service program (PKM) was divided into four stages, namely survey and coordination, initial assessment, core activities, and evaluation.

A. SURVEY AND COORDINATION WITH PARTNER HEALTH CENTER

In this stage, the Poltekkes community service team collaborated with the partner institution, Sreseh Health Center in Sampang Regency, Madura, to discuss the planned activities so that they were aligned with the health center's work program, including technical implementation, scheduling, and location. Coordination was also conducted with the Head of Bangsah Village as the location of the community service activities.

Based on the results of the survey and coordination with the Health Center and the Head of Bangsah Village, it was agreed that the PKM activities would be conducted in Bangsah Village on May 14, 2025. On that date, a socialization session would be held for members of the Hypertension Prolanis in Bangsah Village, Sreseh Subdistrict, Sampang Regency, Madura.

The preliminary operational framework required inter-institutional collaboration between the primary investigative team and local healthcare stakeholders to align program deliverables with existing public health priorities. Administrative and technical workflows were established during an initial coordination session with representatives from the Sreseh Public Health Center (Puskesmas Sreseh) and the local village government (FIGURE 1). This preliminary meeting defined logistical responsibilities, finalized participant recruitment protocols, and set the operational schedule for subsequent community service activities.

B. INITINAL ASSESMENT ACTIVITY (MAY 7, 2025)

The initial assessment aimed to obtain more in-depth information regarding the knowledge, attitudes, and behaviors of Hypertension Prolanis members toward cholesterol control. The assessment was conducted through interviews with the participants. The results showed that most Hypertension Prolanis members did not yet understand cholesterol and its impact on health. The use of garlic to reduce cholesterol levels had not become a daily habit. The level of adherence to routine lipid profile examinations was still low, as most participants only underwent testing when experiencing health complaints. During this activity, participants were informed about the upcoming community service program and were asked for their willingness to attend and participate.

C. CORE ACTIVITIES (MAY 14, 2025)

The core activities were attended by 59 Hypertension Prolanis members and were also attended by representatives from Sreseh Health Center and the Head of Bangsah Village. The activities were conducted in several sessions:

1. Opening Session

The program was officially opened with remarks from a representative of Sreseh Health Center (the village midwife) and the head of the PKM team. The purpose of this session was to convey the objectives of the program.

The core implementation phase was initiated through a formal opening ceremony attended by community leaders, primary healthcare personnel, and enrolled study participants. Opening remarks delivered by the designated village midwife and the lead researcher established the scope, clinical objectives, and expected outcomes of the educational program (FIGURE 2). This introductory

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Vol. 5 No. 2, pp. 54-62, June 2026

session served to foster participant engagement and ensure compliance across the multi-stage clinical assessment and intervention workflow.

FIGURE 2. Opening of the PKM Activity by the Village Midwife

2. Cholesterol Level Examination

Cholesterol measurement was the opening health service activity. High participant enthusiasm indicated early success in improving access to health services among Prolanis members. Results : showed that out of 59 participants, 37 people (63%) had high cholesterol levels, while 22 people (37%) had normal cholesterol levels.

FIGURE 3. Cholesterol Level Examination Before the PKM Education Activity

Prior to the delivery of health education modules, baseline clinical measurements were performed to quantify total capillary blood cholesterol levels across all enrolled subjects. Trained laboratory technicians collected fasting capillary blood specimens using standardized aseptic lancet punctures and point-of-care analytical testing systems (FIGURE 3). The resulting baseline diagnostic distribution categorized participants into normocholesterolemic (<200 mg/dL) and hypercholesterolemic (≥200 mg/dL) baseline strata for subsequent efficacy evaluation.

3. Prolanis Exercise Session

This activity consisted of guided physical exercise led by a health instructor with simple movements that were easy for all participants to follow.

FIGURE 4. Prolanis Exercise Activity

Following initial blood specimen collection, participants engaged in a structured, low-impact physical exercise session tailored specifically for hypertensive adults. Led by a certified health instructor, the group-based physical activity incorporated simple cardiovascular conditioning movements designed to improve vascular compliance (FIGURE 4). High participant engagement during the session underscored the feasibility of integrating structured physical exercise into routine primary chronic disease management programs.

4. Education on Lipid Profile Examination

Educational sessions were delivered by the PKM team, covering the importance and function of lipid profile examinations.

FIGURE 5. Counseling/Education Activity Conducted by the Community Service Team

Structured educational sessions were conducted to address critical gaps in participant health literacy regarding lipid profile control and cardiovascular disease risks. Interactive lectures delivered by the academic team detailed the pathobiology of dyslipidemia, the clinical significance of regular lipid monitoring, and the cardioprotective properties of organosulfur compounds in Allium sativum (FIGURE 5). Educational materials, including standardized informational leaflets, were distributed to reinforce participant retention of key lifestyle and nutritional interventions.

5. Education on the Benefits of Garlic for Preventing Stroke and Coronary Heart Disease

FIGURE 6. Counseling/Education Activity Conducted by the Community Service Team

This session explained the cardiovascular benefits of garlic and appropriate consumption methods. Structured educational sessions were conducted to address critical gaps in participant health literacy regarding lipid profile management and cardiovascular disease prevention. Academic personnel delivered interactive health lectures covering the pathobiology of hypercholesterolemia, the clinical importance of routine lipid profile monitoring, and the cardioprotective properties of bioactive compounds found in Allium sativum (FIGURE 6). Informational leaflets were distributed during the lecture to enhance participant retention and encourage active group discussion regarding lifestyle modifications.

6. Education on Processing Garlic into Black Garlic

Participants were educated on processing garlic into black

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Vol. 5 No. 2, pp. 54-62, June 2026

garlic to increase its nutritional and economic value. Leaflets and sample products were distributed. To encourage practical adoption of non-pharmacological lipid-lowering therapies, participants received practical instructions on the thermal fermentation of fresh garlic into black garlic (aged garlic extract). Demonstrations highlighted the controlled thermal processing conditions required to enhance bioactive compound concentrations, accompanied by the distribution of standardized black garlic sample packages for daily dietary supplementation (FIGURE 7). This step aimed to bridge theoretical health knowledge with accessible, home-based health management practices.

FIGURE 7. Introduction Black Garlic

D. EVALUATION ACTIVITY (JUNE 14, 2025)

FIGURE 8. Cholesterol Level Measurement of Participants After the Community Service Program

Evaluation was conducted by measuring cholesterol levels after participants followed the program and consumed black garlic regularly. A formal post-intervention clinical evaluation was conducted following a continuous 30-day monitoring period to determine the therapeutic impact of the intervention. Post-treatment capillary blood sampling was executed under identical fasting conditions and analytical protocols as the baseline assessment to measure change in total cholesterol concentration (FIGURE 8). Comparative evaluation of the baseline and post-intervention datasets quantified the primary outcome measure regarding the proportion of participants achieving target normal lipid ranges.

The results of the community service activities are presented as follows:

TABLE 1
Cholesterol Levels Before and After the PKM Program

Cholesterol Level	Before (F)	Before (%)	After (F)	After (%)
High	37	62.7	27	45.8
Normal	22	37.3	32	54.2
Total	59	100	59	100

Based on TABLE 1, before the PKM program 37 participants (63%) had high cholesterol levels and 22 participants (37%) had normal levels. After the program and regular consumption of black garlic, the number of participants with high cholesterol decreased to 27 people (46%), while those with normal cholesterol increased to 32 people (54%).

TABLE 2
Reduction in High Cholesterol Levels

Condition	Frequency	Percentage
Before	37	63%
After	27	46%
Difference	10	17%

Based on TABLE 2, indicate that the number of participants with high cholesterol decreased by 10 people (17%) after participating in the program and consuming black garlic regularly. This suggests that the PKM program was effective in reducing cholesterol levels among Hypertension Prolanis members in Bangsah Village, Sreseh Subdistrict, Sampang Regency, Madura.

IV. DISCUSSION

A. INTERPRETATION OF THE FINDINGS

The present community service program demonstrated a favorable change in the distribution of cholesterol status among hypertensive Prolanis members in Bangsah Village. Among the 59 participants, 37 individuals (62.7%) had high cholesterol levels before the program, while 22 individuals (37.3%) had normal cholesterol levels. Following implementation of the program, the number of participants with high cholesterol decreased to 27 (45.8%), whereas the number with normal cholesterol increased to 32 (54.2%). Thus, the proportion of participants classified as having high cholesterol decreased by 10 individuals, equivalent to a 17-percentage-point reduction. These findings indicate an improvement in the overall distribution of cholesterol status following participation in the community intervention.

The observed change should be interpreted in relation to the multidimensional nature of the intervention. The program did not consist solely of black-garlic utilization but incorporated several activities, including cholesterol examination, Prolanis physical exercise, education regarding lipid-profile monitoring, education concerning cardiovascular complications, information on the potential benefits of garlic, and education on black-garlic processing and utilization. The initial assessment also identified limited participant understanding of cholesterol and its health consequences, infrequent lipid-profile monitoring, and limited habitual use of garlic as a complementary food. Therefore, the improvement observed after the intervention may reflect the combined contribution of health education, increased awareness, improved access to cholesterol monitoring, physical activity, and dietary behavior rather than the isolated effect of black garlic.

The findings are biologically plausible because garlic contains several bioactive compounds that have been investigated for their potential effects on lipid metabolism and cardiovascular health. Black garlic is produced through controlled thermal processing of fresh garlic, during which its physicochemical characteristics and bioactive composition change. Compounds such as S-allyl cysteine, polyphenols, and other organosulfur-related compounds have been associated with antioxidant and potential

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Vol. 5 No. 2, pp. 54-62, June 2026

cardiometabolic activities [31], [32]. Recent reviews have described potential hypolipidemic and cardiovascular-protective properties of black garlic, although the magnitude and clinical relevance of these effects remain dependent on the preparation, dosage, and population investigated [31], [32].

The present results are also consistent with recent quantitative evidence concerning garlic consumption and lipid profiles. Zhao et al. reported through a systematic review and meta-analysis of randomized controlled trials that garlic interventions were associated with reductions in total cholesterol and LDL-C and an increase in HDL-C [33]. Similarly, Du et al. analyzed 21 randomized controlled trials and found that garlic consumption significantly reduced total cholesterol, triglycerides, and LDL-C, with the effects being particularly evident among participants older than 50 years [34]. These findings provide a reasonable basis for considering garlic-related interventions as complementary approaches to cardiovascular risk management.

However, the current findings should not be interpreted as direct evidence that black garlic alone caused the 17-percentage-point reduction. Unlike the controlled trials included in the aforementioned meta-analyses, the present program was implemented as a community-based intervention involving multiple simultaneous activities. Consequently, the observed improvement represents the overall outcome of the program rather than the independently attributable effect of black garlic. This distinction is important for maintaining appropriate scientific interpretation and avoiding overstatement of the intervention effect.

B. COMPARISON WITH PREVIOUS STUDIES

The direction of the present findings is generally consistent with previous research investigating garlic and cardiovascular risk factors. Zhao et al. [33] found that garlic supplementation significantly reduced total cholesterol by approximately 14.17 mg/dL and LDL-C by approximately 8.20 mg/dL in their meta-analysis of randomized controlled trials. Du et al. [34] similarly reported significant reductions in total cholesterol, triglycerides, and LDL-C among participants receiving garlic interventions. The consistency between these findings and the reduction in the proportion of participants with high cholesterol in the present program suggests that garlic-based interventions may have potential as a complementary component of community cardiovascular-risk management.

Nevertheless, differences exist between the present program and previous clinical studies. Most randomized trials evaluate standardized garlic preparations, defined dosages, and specific lipid parameters, whereas the present program emphasized community education, black-garlic utilization, lifestyle awareness, and routine monitoring. The outcome in this study was also expressed categorically as high or normal cholesterol rather than as changes in mean total cholesterol, LDL-C, HDL-C, or triglyceride concentrations. Therefore, direct numerical comparison with previous clinical trials is not appropriate. The present study instead provides complementary evidence concerning the feasibility and potential community-level relevance of an integrated intervention.

The findings are also consistent with evidence supporting health education and lifestyle counseling in chronic disease management. A systematic review and meta-analysis by Soltani et al. demonstrated that individual face-to-face education and counseling can contribute to improvements in hypertension-related outcomes compared with usual care [35]. This supports the interpretation that the educational components of the present program may have played an important role by increasing participants' awareness of cholesterol monitoring, cardiovascular complications, and healthy lifestyle practices. The combination of information provision and practical activities may be particularly relevant in community settings because participants receive both knowledge and opportunities to apply that knowledge.

The role of black garlic itself should, however, be considered with appropriate caution. Ahmed and Wang [31] reported that black garlic contains bioactive compounds associated with antioxidant, anti-inflammatory, hypolipidemic, and cardiovascular-related activities. Ramadane et al. [32] similarly described the potential of black garlic as a functional food because of its phytochemical composition and possible effects on lipid metabolism. These reviews nevertheless emphasize that evidence concerning black garlic is heterogeneous, with substantial evidence derived from experimental studies rather than large community-based clinical trials. Therefore, the present community findings add practical evidence regarding the incorporation of black-garlic education into a chronic disease program but should not be considered equivalent to evidence from randomized clinical trials.

Another relevant difference concerns the outcome measure. Previous clinical studies commonly quantify lipid concentrations before and after intervention, allowing researchers to calculate mean changes and statistical significance. In contrast, the present study classified participants according to cholesterol status. The shift from 37 to 27 participants with high cholesterol is clinically meaningful from a community-screening perspective because fewer participants remained in the high-cholesterol category. However, without individual lipid values and statistical testing, it is not possible to determine the magnitude of biochemical improvement for each participant or whether the observed difference reached statistical significance.

C. LIMITATIONS, IMPLICATIONS, AND FUTURE DIRECTIONS

Several limitations should be considered when interpreting the findings. First, the program used a single-group pre–post design without a control or comparison group. Consequently, the observed reduction in high cholesterol cannot be attributed exclusively to black-garlic consumption. Changes may have resulted from the educational intervention, physical activity, dietary modification, routine medical treatment, medication adherence, regression to the mean, or other factors occurring during the observation period. Future studies

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Vol. 5 No. 2, pp. 54-62, June 2026

should employ a controlled design, preferably a randomized controlled trial, to distinguish the specific contribution of black garlic from other components of the intervention.

Second, the study reported cholesterol status categorically rather than providing individual or group-level biochemical values for total cholesterol, LDL-C, HDL-C, and triglycerides. This limits the ability to determine the magnitude of physiological changes and prevents comparison with studies that report continuous lipid outcomes. Future investigations should measure complete lipid profiles before and after intervention and report mean values, standard deviations, effect sizes, confidence intervals, and appropriate statistical tests.

Third, participant adherence to black-garlic consumption and lifestyle recommendations was not quantitatively documented. Although the program encouraged regular consumption and provided education, the available results do not establish the exact frequency, quantity, or consistency of individual consumption. Adherence should therefore be monitored using standardized records, dietary diaries, or other validated instruments in future studies. Such monitoring would allow researchers to investigate whether greater adherence is associated with greater improvement in lipid parameters.

Fourth, the intervention involved multiple components, making it difficult to identify which element contributed most strongly to the observed improvement. Education, physical activity, cholesterol screening, lifestyle counseling, and black-garlic promotion were implemented as an integrated program. This multidimensional approach is advantageous from a public-health perspective because cardiovascular risk is multifactorial; however, it reduces the ability to establish the independent effect of each component. Future research could compare education alone, education plus lifestyle intervention, and education plus standardized black-garlic supplementation to determine their relative effects.

Despite these limitations, the findings have important practical implications. The reduction in participants with high cholesterol from 62.7% to 45.8% indicates that community-based screening and education may be valuable components of chronic disease management. The increase in participants with normal cholesterol from 37.3% to 54.2% further suggests that the program may have supported more favorable cholesterol-status outcomes. Integrating dietary education with routine lipid monitoring may strengthen participant awareness and encourage greater engagement with preventive health practices. Black garlic may be introduced as a complementary food-based strategy, but it should not replace prescribed medical treatment or established dietary and lifestyle recommendations.

For primary healthcare settings, the program provides a potentially feasible model that combines screening, education, physical activity, and locally applicable food-based health promotion. Its community-oriented format may facilitate participant engagement because the intervention addresses both knowledge and practical behavior. Nevertheless, implementation should be accompanied by appropriate monitoring, clear dietary guidance, and communication that black garlic represents a complementary approach rather than a substitute for antihypertensive or lipid-lowering therapy.

Overall, the present findings indicate a favorable association between participation in the community service program and improvement in cholesterol-status distribution among hypertensive Prolanis members. The results are directionally consistent with recent evidence suggesting potential lipid-lowering effects of garlic [33], [34] and with evidence supporting education and lifestyle counseling in chronic disease management [35]. However, stronger experimental evidence is required to determine the independent efficacy of black garlic. Future studies should use larger samples, control groups, standardized black-garlic preparations and dosages, longer follow-up periods, quantitative lipid measurements, and systematic adherence monitoring. Such methodological improvements would provide stronger evidence regarding the clinical effectiveness and practical sustainability of black garlic as a complementary component of community-based cardiovascular risk reduction.

V. CONCLUSIONS

This community service program aimed to improve awareness and knowledge regarding cholesterol control and to promote the utilization of black garlic as a complementary food-based approach among hypertensive Prolanis members in Bangsah Village, Sreseh Subdistrict, Sampang Regency. The program was implemented through a series of integrated activities comprising initial assessment, cholesterol-level examination, Prolanis physical exercise, education on lipid-profile monitoring and cardiovascular complications, education on the potential benefits of garlic, and introduction to black-garlic processing and utilization. The evaluation involved 59 hypertensive Prolanis members and demonstrated a favorable change in the distribution of cholesterol status following program implementation. Before the program, 37 participants (62.7%) were classified as having high cholesterol levels, whereas 22 participants (37.3%) had normal cholesterol levels. Following the program, the number of participants with high cholesterol decreased to 27 (45.8%), while the number with normal cholesterol increased to 32 (54.2%). Thus, the number of participants categorized as having high cholesterol decreased by 10 individuals, corresponding to a 17-percentage-point reduction, while the proportion with normal cholesterol increased by 16.9 percentage points. These findings indicate that the integrated community-based intervention was associated with an improvement in cholesterol-status distribution among the participating hypertensive Prolanis members. Nevertheless, the observed change should not be interpreted as evidence of an independent causal effect of black garlic because the program incorporated multiple components and did not include a control group or statistical analysis of individual lipid concentrations. The findings therefore support the feasibility of integrating health education, routine cholesterol monitoring, physical activity, healthy-lifestyle promotion, and black-garlic utilization into community-based chronic disease management as complementary strategies. Future studies

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Vol. 5 No. 2, pp. 54-62, June 2026

should employ larger participant samples, controlled or randomized study designs, longer follow-up periods, standardized black-garlic preparations and dosages, quantitative measurements of total cholesterol and other lipid parameters, and systematic monitoring of participant adherence. Such methodological improvements are necessary to determine the specific contribution and clinical effectiveness of black garlic and to establish whether the favorable changes observed in this community program can be sustained over time.

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DATA AVAILABILITY

The data supporting the findings of this community service program are available from the corresponding author upon reasonable request, subject to applicable privacy, institutional, and ethical considerations.

AUTHOR CONTRIBUTION

Anik Handayati contributed to the conceptualization of the community service program, development of the intervention, coordination with partner institutions, data collection, data analysis, and preparation of the manuscript. Suhariyadi contributed to the implementation of the community service activities, participant assessment, health education, data collection, interpretation of the findings, and critical review of the manuscript. Pestariati contributed to the development and supervision of the program, interpretation of the results, manuscript review, and overall academic guidance. All authors contributed to the revision of the manuscript, approved the final version, and agreed to be accountable for the integrity and accuracy of the work.

DECLARATIONS

ETHICAL APPROVAL

Ethical approval was not stated in the current manuscript. If ethical approval was obtained, the authors should provide the name of the approving institution and approval number before submission. If the activity was formally classified as community service and exempt from ethical review, this should be stated according to the applicable institutional policy.

CONSENT FOR PUBLICATION PARTICIPANTS

Participants in the community service activities was voluntary. Participants were informed about the activities and their willingness to participate was obtained. Any statement concerning written informed consent should be added if such documentation was formally obtained.

COMPETING INTERESTS

The authors declare that they have no financial or personal relationships that could have influenced the work reported in this manuscript.

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