Return on investment of health intervention among diabetic patient: A systematic review

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Abstract. A strategy for reducing healthcare costs of diabetic mellitus (DM) is by reducingbody weight and blood glucose through lifestyle-modification programs such as intensive lifestyle interventions, meal-replacement programs, and physical activity. A return on investment (ROI) analysis needs to be done to see a program's effectiveness, which aims to make this program provide benefits, especially in the long term. In this systematic review, the authors describe ROI, the program, the program's cost, adoption, and implementation. The authors searched the Science Direct, Pubmed, and SAGE databases using the following search terms: 'Return on Investment' AND 'DiabeticMellitus' and Programs". Moreover, hand searching identifies further studies. This review includes eight articles, and most articles on lifestyle modification intervention have great ROI; several articles with public health workers have great ROI. The findings show that long-term and program intensity in a long time horizon plays a major role in outcomes and more significant ROI. Programs with lifestyle intervention fellow health workers or CHWs that helped deliver physical activity, education, and dietary had a good impact in lowering diabetes risk.
Keyword: Diabetic mellituss, life style intervention, program, return on investment.

1 Introduction

The incidence of diabetes mellitus worldwide has increased, which is a global threat [1–3]. The most recent estimate of the number of people with diabetes ranges from 20-79 years of age and is expected to increase to 642 million in 2040, which means that 1 in 10 adults will have diabetes. In addition, in middle and low-income countries, 3 out of 4 adults have diabetes. Diabetes is the cause of 6.7 million deaths worldwide which means that 1 death every 5 seconds. From an economic burden standpoint, diabetes spends 966 billion USD on health costs, and this increase is 315% from the last 15 years [4].

Lifestyle change interventions in improving physical activity and diet can increase the incidence of type 2 diabetes mellitus by 58% within three years; this has been done in the Diabetes Prevention Program (DPP) clinical trial program. This intervention's benefits were also shown for the next 10 to 15 years [5, 6]. The results of the DPP issued a recommendation that overweight or obese adults with at least one risk factor for cardiovascular disease receive behavioral counseling to minimize the severity of complications [3, 7–9].

This intervention also was a strategy to reduce the cost of treating DM, which showed that modifying lifestyle with intensive intervention through a diet program reduces the health cost of DM [10, 11]. Weight loss in DM patients has been shown to provide benefits in terms of health costs, both hospitalization costs and medical expenses in DM patients. Diabetic patients with excess weight incur higher medical costs than diabetic patientswith normal weight [12, 13]. The government's agenda and making a national plan for managing the prevalence of DM, providing a budget for the DM program will be more beneficial in the long term when viewed from the value of the cost of health costs caused by DM disease [40]. The results of the NDPP and the Diabetes Prevention Program Observation Studyconfirm that lifestyle interventions and metformin are equally cost-effective [14].

Evaluation of DM disease prevention programs has beenaffordable, only limited to its implementation and effectiveness in financing and the health of DM sufferers. Economic effectiveness can be assessed by ROI analysis by assessing the benefits of program interventions to obtain a return on investment (ROI) value from the health system perspective [15]. In this systematic review, the authors explain the types of interventions implemented, the costs, and the value of the ROI resulting from the interventions. A review of ROI will be beneficial in making diabetes-related policies. This review will provide priority recommendations that are most effective and profitable long-term so that therapy in diabetes patients will be more cost-effective.

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2 Methods

2.1 Search Strategy

The authors systematically reviewed the completed ROI values from program interventions aimed at prediabetic patients or diabetics. This systematic review is part of a research study ROI analysis in health programs in Indonesia with a code of ethics number KE/FK/1652/EC/2022. The disbursement database, Pubmed, Science Direct, and SAGE, uses the following search keywords 'Return on Investment' AND 'Diabetic Mellitus' AND 'Intervention'. A hand search was performed to identify further studies. The limit in this particular payment is the last ten years of articles and articles in English.

2.2 Study Selection an Inclusion Criteria

The studies included in this systematic are each ROI study with an intervention design for diabetes patients in the community. These included articles from the past ten years. The authors search for program interventions related to the science and art of promoting and protecting health and well-being to prevent ill health and prolong life through community-organized efforts for diabetes prevention and diabetes in high-income countries. The program is then assessed economically by return on investment analysis. This systematic review is based on items in the Systematic Review and Meta-Analysis (PRISMA) [16]. The authors screen original articles with full text related to interventions in diabetes patients and are in English. Theexclusion criteria in this study did not count the variablereturn on investment, and the article was incomplete.

2.3 Selection Article and Data Extraction

The first investigator (KI) initially screened the article titles. Investigators (KI) independently review the relevance of titles and abstracts of articles that are fit for purpose. The results of the articles were then discussed by (SA) and (DE) by reading the entire manuscript. The investigator (TM) then independently extracted and assessed the quality of the articles. Next, the reviewer (SA) decides on the assessment results and the article's qualit.

3 Result

3.1 Study Selection

An article search was conducted on Pubmed, ScienceDirect, and SAGE, and the article was found (Figure 1). n = 428 journals from PubMed, n = 120 journals from ScienceDirect, and n = 83 from SAGE Journals. Article screening was carried out by reading article titles and abstracts relevant to the inclusion criteria and identifying 89 potentially relevant titles. At Positioning this stage, 89 articles were read thoroughly to assess their suitability with the desired outcome in a systematic review. From this process, articles will be decided according to the objectives of the systematic review, and some articles were excluded for the following reasons, complete articles were not found (n=34), duplicates(n=9), and excluded for other reasons (n=30). In-depth review of the full text was excluded because the results did not meet the inclusion criteria and study protocol. Therefore, eight articles are relevant Place the figure as close as possible after the point where it is first referenced in the text. If there is a large number of figures and tables it might be necessary to place some before their text citation.

3.2 Study Characteristic

Table 1 describes the characteristics. The eight studies were conducted in the UK, USA, and around. The duration of this study ranged from 1 years-10 years. Two perspectives appear in the article: the perspective of the payer and the provider payer perspective is used in articles [15, 17], and the payer perspective is used in articles [15, 16, 18–21]. Studies with a payer perspective are the perspectives of companies such as insurance, private companies, or the government, which will pay for costs related to health services provided to participants. The costs considered in this perspective are direct costs, but the analysis can consider indirect costs such as lost productivity or lost workdays [22]. Lifestyle intervention was a health plan with a healthy diet and physical activity for obese, diabetes, and prediabetes patients [17–19, 23, 24]. Counseling-based programs are carried out in various ways, starting from providing material, medical journals given to the patient, digital intervention, and education face-to-face with patients facilitated by health workers [15, 20, 21]. There was also research on counseling interventions and therapy for DM patients with foot ulcers [20]. A health service provider's perspective is the actual value of the product or health service provided by the health service. These include direct costs, namely professional service fees, hospitalization costs, medical expenses, laboratory examination fees, and consumables [22].

3.3 ROI Specialism Programin Dealing with Diabetes Mellitus

3.3.1 *Counseling health public and health workers' intervention.*

There were three articles on counseling, public health, and health workers' intervention. The value of the cost of intervention from these articles ranges from 115-500 USD. The ROI value range is 7.4-9.01. Figure 2 shows that the highest ROIvalue is 9.01, with a time horizon of 3 years.

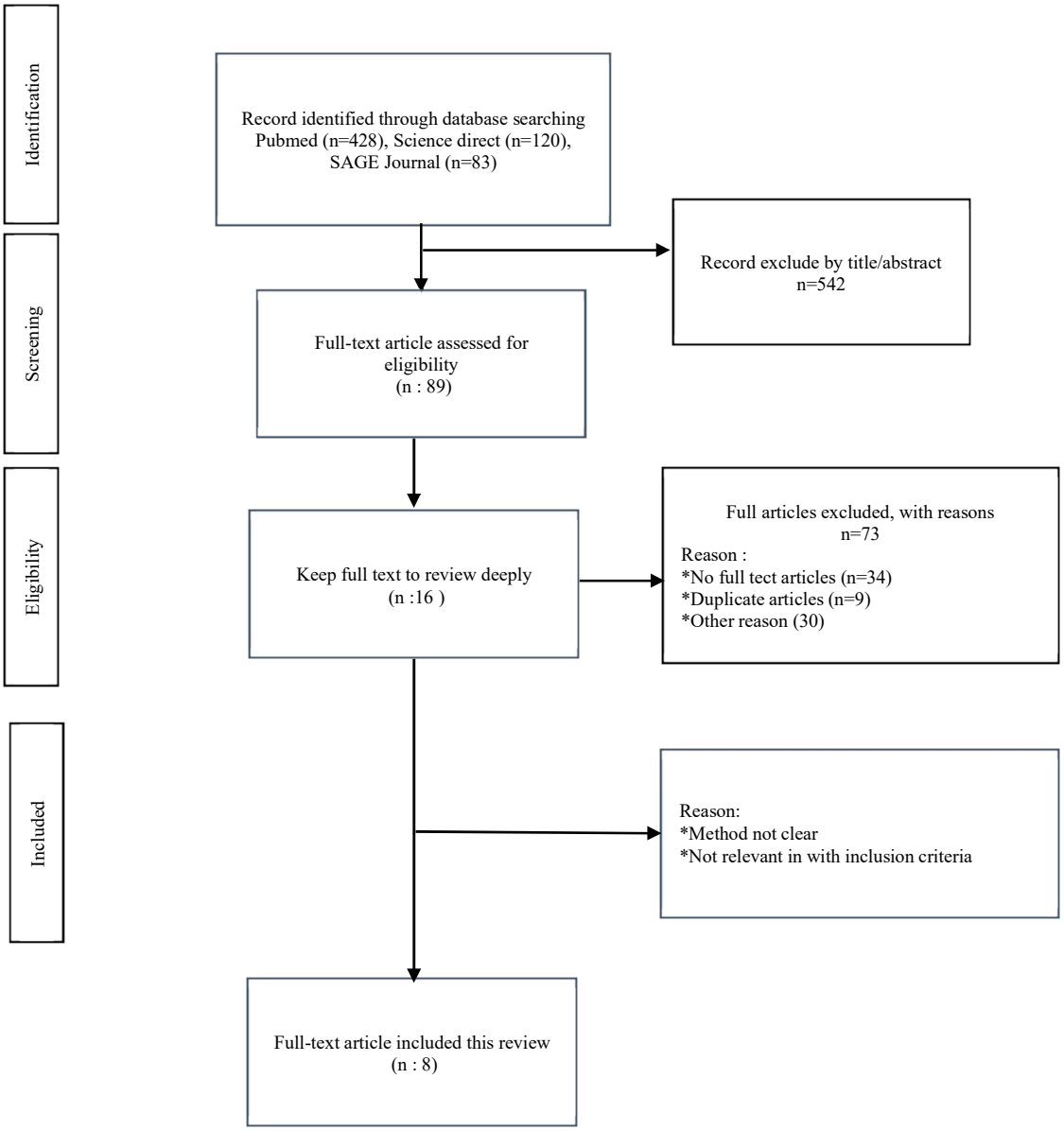


Fig. 1. Prisma Flow Diagram

Table 1. Summary Study Characteristics

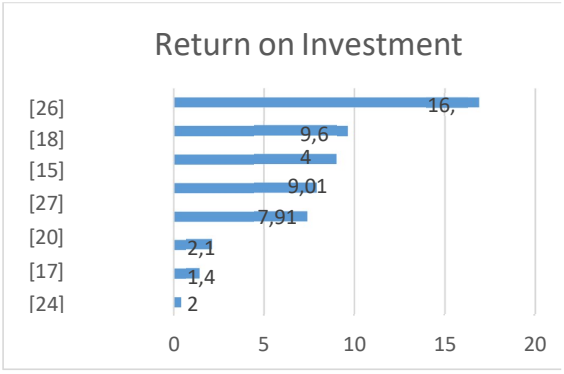
Reference	Intervention	Population	ROI	Cost perspective	Discount rate	Time horizon
[24]	Lifestyle intervention	UK	1,42	Provider	3,5%	5 years
[15]	Lifestyle intervention	USA	9,01	Provider and Payer	3%	3 years
[26]	Lifestyle intervention	USA	16,9	Payer	3%	10 year
[18]	Lifestyle intervention	USA	9,64	Payer	None	5 years
[19]	Lifestyle intervention	USA	0,42	Payer	None	3 years
[20]	Counseling health public and health workers intervention	Canada	7,4	Payer	None	1 year
[27]	Counseling and health public and health workers intervention	USA	7,9	Payer	3%	3 year
[17]	Counseling and health public and health workers intervention	California	2,1	Provider and Payer	3%	3 years

Table 2. Public Health Programs and Cost of Programs

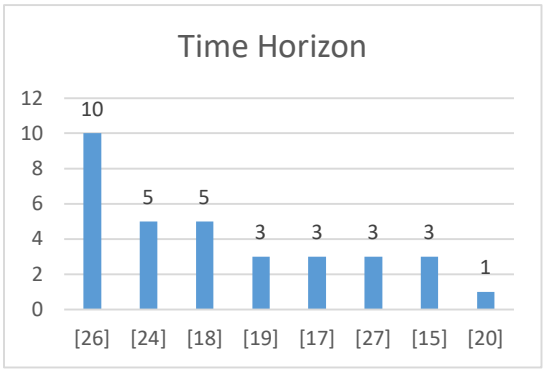
Reference	Intervention	Detail Programs	Cost of Programs/person/USD
[24]	Lifestyle intervention	healthy lifestyle interventions by providing education on healthy diets, physical activity and weight loss targeted at individuals at high risk of DM and DM	284,2
[15]	Lifestyle intervention	Intervention study with 2 groups, control group and intervention group. In the intervention group, healthy lifestyle activities, namely ILI (intensive lifestyle intervention) were carried out. Comparing the cost saving of the two groups	342
[26]	Lifestyle intervention	Weigh and Win (WAW), by Incenta HEALTH LLC is a community-based weight loss program	1487
[18]	Lifestyle intervention	Lifestyle habit intervention through education with an appeal to reduce alcohol, smoking, more excercise and consume more vegetables and fruit. Participants are given a journal that will be checked every month	None
[19]	Lifestyle intervention	Healthy lifestyle interventions for prediabetic patients and seeing the potential for continuity against the risk of DM disease for this group	None
[20]	Counseleling health public and health workers intervention	Diabetic foot care clinical pathway (DFCCP) in diabetic foot wound patients. There are two DM groups, a control group with treatment and an intervention group with treatment	500
[27]	Counseling health public and health workers intervention	Implement National DPP is a partnership of public and private organizations providing intensive training in diet, physical activity, and behavior modification	200-400
[17]	Counseling health public and health workers intervention	Comparing the intervention of DM patients with regular (PCP) therapy vs diabetes intense medical management (DIMMs)	115-164

3.3.2 *Counseling health public and health workers' intervention.*

There were five articles with lifestyle interventions. Table 2 shows that cost of lifestyle interventions ranges from 248.2-1487 USD. Several articles do not include the value of the cost of intervention but still display the ROI value. ROI values in lifestyle intervention range from 0.42-16.9. The highest value is 16.9, with an estimated interventionif it is carried out for ten years.



(a)



(b)

Fig. 2. The graph gender of (a) Return on Investment and (b) Time Horizon

4 Discussion

ROI can be used in calculating a program's intervention or several interventions if the company has a large-scale scope and can also be one of the measuring indicators to be compared with other interventions [28]. Assessing the ROI ratio is seen from how much the ratio is. ROI is greater than or equal to 1, then the program has a practical value because it has value equal to or more than the cost of implementation. In this case, the ROI value is considered positive. For example, an ROI of 1.8 indicates that for every 1 rupiahinvested in the program, the agency will earn a profit of 1.80 rupiah. If, ROI is less than 1, then the interventionsuffers a loss. In this case, ROI is considered negative. For example, ROI-1.5 shows that for every 1 dollar invested, the agency suffers a loss of 1.50 rupiah. If theROI value is 0.8, then for every 1 dollar invested, 0.8 dollars will be obtained by the agency, while the agencywill lose 0.2 dollars for every 1 dollar spent on the program [29]. Most of the articles do interventions in lifestyle modifications. These lifestyle modifications include physical activity and diet. In the articles, interventions are different; this is also related to the results to be achieved. Several articles measure effectiveness in comparison with a control group. In comparison with the control group, the value of cost saving can also be seen from the comparison with the reduction of the two groups [17, 24]. The article provides an intervention in which participants are asked to complete household tasks, including self-monitoring ofeating and physical activity. The physical activities will be in the form of safety training, stretching, basic strength training, and increasing activity levels witheach predetermined schedule [17–19, 23, 24] There are two interesting findings in a systematic review regarding ROI in interventions in DM patients.

First, even with the most basic economic evaluation, it is clear that most public health interventions include with monitoring and lifestyle intervention are substantial cost savings. It confirms our theory that public health interventions generally offer a sizable ROI. Overall, the results of our systematic review clearly show that public health interventions save costs for health services and the wider economy. Besides, some very rapid: preventive interventions report substantial results within one year. Greater return on investment seen over the ten years horizon. It has significant implications for policymakers, who often work with shorter time horizons (usually 3–5 years). It is in line with previous research that the intervention of physical activity and diet positively affects weight loss and blood sugar [2, 21, 30].

Second, health worker-based interventions provide a relatively high ROI value compared to physical activity and diet alone. Intervention with physical activity and diet provides high effectiveness if given in the long term. This positive result from [15] is driven by the large difference in HbA1c results achieved in the DIMM versus the PCP group, as well as the relatively low cost of pharmacist interventions designed as a limited series of visits to treat patients. Interventions with health workers have many benefits and effectiveness, especially in patient health, and can avoid long-term complications and a better quality of life [31, 32]. Education intervention for diabetic programs in adults showed a good impact on cost saving if given in the long term, at least with 1 year duration [33, 34]. One article is about diabetic foot care, and that showed good ROI. The positive results of providing regular foot wound care to DM patients with foot wounds indicate that cost savings can be obtained if the patient receives regular and long-term care [20].

Cost saving is a benefit variable to measure the successof a program by assessing the cost saving. ROI analysisis obtained by dividing the net benefit value by the intervention cost. In other words, the net benefit here issignificant, obtained from the cost saving minus the

intervention cost value. The benefit value in the net benefit has the same concept as the net profit value [35]. The current study shows that the impact of an effective program for diabetes in adult patients correlates with cost savings, savings from complications, and also comorbidities [33, 23, 25]. This finding is similar to estimates of cost savings reported in previous studies. For example, 12-month pre- and post-education cost data were examined for diabetes program participants, with $815 direct cost savings through the program and $1504 indirect cost savings through changes in comorbid disease burden [36]. There is a correlation between clinical outcomes and cost-effectiveness in providing usual care and lifestyle interventions for DM patients. Bringing patients, providers, and the healthcare system together and integrating public health workers as liaisons between patients is an excellent approach to effective diabetes management [37]. Other studies that showed cost saving of diabetes intervention showed good member health workers to manage diabetes can reduce comorbid condition, cost, and HbA1C [4, 36, 38].

Studies find it important to consider the long-term impact to capture the full ROI and find positive ROI values [20]. Programs designed for cost-saving can be looked at in the short-term, medium-term, and long-term. To see good and effective service quality requires an affordable intervention program so that it can be carried out in the long term. Identification of good ROI can be seen from how well the profit is given in the long term [39]. The authors recommend that advisory bodies regularly emphasize that public health interventions can offer rapid results, which can increase further in the long term. The limitations of this review are that several articles did not mention the value of the discount rate and cost of intervention. Some articles did not explain in detail the interventions carried out. Very little has been done regarding research conducted by research authors regarding ROI. Many studies on ROI have been conducted in developed countries, but only a few focused on diabetes and public health.

5 Conclusion

The findings show that long-term and program intensity in a long time horizon plays a major role in outcomes and more significant ROI. Programs with fellow lifestyle intervention deliver physical activity, education, and dietary had a good impact in lowering diabetes risk. The authors recommend that advisory bodies regularly emphasize that public health interventions canoffer rapid results, which can increase further in the longterm.

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