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COST-EFFECTIVENESS ANALYSIS (CEA) OF A TOBACCO INITIATION INTERVENTION FOR COLLEGE STUDENTS IN TÜRKİYE[ξ]

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Abstract

Economic evaluation is essential for the efficient use of public resources and, especially, for the scale-up decisions of the new programs. This study provides a full economic evaluation of a 27-month tobacco control project for college students in Ankara, Türkiye. Tobacco use among young adults is of particular concern in Türkiye because of rising prevalence in recent years. The study calculates the sample and population level relative cost-effectiveness ratios (CERs). Study found that while the sample-level CER for recall was ₺680,91 and for prevented initiation was ₺2,138.05, the extrapolated CERs were ₺34,96 and ₺105.44, respectively. Reponse to a direct cross-check project effectiveness question in the questionnaire indicated that the project prevented the initiation of 571 never-smoked students. Given this, prevented initiation CER is ₺2,289.18, which is quite similar to survey aggregate CER of ₺2,138.05 for preveneted initiation. Study also found that booth administered during special day was the most cost-effective intervention item while short videos were the least cost-effective ones. The findings of the study will better guide resource allocation and will be instrumental in policy decisions for scaling up the project to all higher education institutions in Türkiye.

Keywords: *Tobacco Use, Tobacco Burden, Tobacco Control, Economic Evaluation, Cost-Effectiveness Analysis*
JEL Classification: *D04, I18, P35*

TÜRKİYE'DE ÜNİVERSİTE ÖĞRENCİLERİNE YÖNELİK TÜTÜNE BAŞLAMA MÜDAHALESİNİN MALİYET ETKİLİLİK ANALİZİ (MEA)

Öz

Ekonomik değerlendirme, kamu kaynaklarının verimli kullanılması ve özellikle yeni programların yaygınlaştırılması kararlarında önemlidir. Bu çalışma, Ankara, Türkiye'deki üniversite öğrencilerine yönelik 27 aylık bir tütün kontrolü projesinin tam ekonomik değerlendirmesini sunmaktadır. Son yıllarda artan yaygınlık nedeniyle Türkiye'de genç yetişkinler arasında tütün kullanımı özellikle endişe vericidir. Çalışma, örneklem ve nüfus düzeyinde göreceli maliyet etkinlik oranlarını (MEO) hesaplamaktadır. Farkındalık göstergesi olarak hatırlama için örneklem düzeyindeki MEO ₺680,91 iken engellenen başlama için MEO ₺2.138,05 olarak tespit edilmiştir. Nüfusa ekstrapole edilmiş MEO'lar ise sırasıyla ₺34,96 ve ₺105,44'tür. Proje anketinde çapraz kontrol maksadıyla sorulan etkililik sorusuna verilen yanıt, proje müdahalelerinin 571 hiç tütün kullanmamış öğrencinin tütüne başlamasını önlediği tespit edilmiştir. Buna göre, engellenen başlatma MEO'su ₺2.289,18'dir ki bu rakam ₺2.138,05'lik MEO'ya oldukça yakındır. Araştırmada stantların en yüksek, kısa videoların ise en az maliyet etkili müdahale öğesi olduğu bulgusuna ulaşılmıştır. Çalışmanın bulguları kaynak tahsisine daha iyi rehberlik edecek ve projenin Türkiye'deki tüm yükseköğretim kurumlarına yaygınlaştırılmasına yönelik politika kararlarında etkili olacaktır.

Anahtar Kelimeler: *Tütün Kullanımı, Tütün Yükü, Tütün Kontrolü, Ekonomik Değerlendirme, Maliyet Etkililik Analizi*
JEL Sınıflandırması: *D04, I18, P35*

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1. Introduction

Economic evaluation of government programs, projects, and interventions guides efficient resource allocation and scale-up decisions of pilot projects. Economic evaluation is used to systematically compare the resource use (inputs) of programs, projects, and interventions to their consequences (Drummond, et al. 2015). Without a properly conducted economic evaluation, ensuring the best use of scarce public funds for, especially, the new programs will at best be coincidental. In this context, this study provides cost-effectiveness analysis (CEA) of a tobacco initiation prevention project implemented for college students in Ankara, Türkiye.

CEA compares the costs of projects and programs to their effects, which are changes in project-related natural magnitudes of outcomes. The study calculates the unit costs of prevention of initiation and awareness, measured in terms of message recall, generated. The study seeks answers to the following crucial policy-related questions: What is the cost of each prevented tobacco initiation? What is the cost of each awareness generated? Which intervention campaign is more cost-effective?

Health behaviors (use of tobacco products, alcohol use, nutrition, hygiene, exercise, etc.) are one of the important factors explaining health costs and outcomes. Therefore, attitude and behavior change interventions that encourage healthy behaviors are on the rise worldwide. This includes interventions that try to prevent young people from initiating tobacco use in the first place, and there is evidence of the effectiveness of these interventions. For example, the tobacco control media campaign 'The Real Cost' is associated with preventing (estimated) 348,398 young people aged 11-18 from initiating tobacco use between 2014 and 2016 in the United States of America (USA) (Farrelly, et al., 2017). According to World Health Organization (WHO), tobacco control intervention programs are the most cost-effective social interventions (Jiang, et al., 2022; Shearer and Shanahan, 2006). Since tobacco-related health costs are so high, the ROI of tobacco control intervention campaigns is also quite high. A tobacco control intervention in the U.S. state of Washington has been found to provide a 1 to 400 return on investment (Dilley, et al., 2012). Governments pour in significant amounts of funds for tobacco control due to concerns about future costs, but these programs are no exception to systematic comparison of resources used and the consequences.

Tobacco use is associated with several health problems and is recognized as a preventable risk factor for six of the eight leading causes of disease and death globally (WHO, 2008). This factor constitutes a serious and increasing public health concern on a global scale. Future projections suggest that tobacco use will kill more than 8 million people worldwide each year by 2030, with 80% of these premature deaths occurring in low- and middle-income countries (WHO, 2016). According to the WHO, there are approximately 1 billion smokers in the world, and 80% of them are in developing countries (WHO, 2011). Tobacco use has many detrimental effects on health. It is estimated that people who use tobacco have an estimated risk of dying 10 years earlier on average than those who do not (CDC, 2016; Jha, et al., 2013). Also, tobacco use causes loss of production and it requires public spending for health care and tobacco control measures. Because of the avoidable/preventable nature of tobacco use, the burden of tobacco can be considered a welfare loss that requires action to prevent the wastage of valuable public resources.

Considering health costs and production loss, tobacco use is a costly endeavor for the person who smokes and for the whole society she or he lives in. Tobacco use is of particular concern in Türkiye because of the higher and increasing prevalence, especially among young adults. In 2019, more than 65% (54.3 million/83.2 million) of Türkiye's population was over the age of 20 and of which about 44% (23,7 million) were tobacco users and quitters. Tobacco use is a major risk factor for diseases, disabilities, and death, globally. This is also true for Türkiye. According to the global burden of disease study (IHME, 2019), the highest contributing risk factor for disease

burden, measured in Disability-Adjusted Life Years (DALYs), in Türkiye is tobacco (cigarettes, chewing tobacco, and secondhand smoke) use.

The study is organized as follows: Section 2 is allotted for the review of the existing literature related to this study. Section 3 explains the intervention project implemented for tobacco initiation prevention. Section 4 offers costing and cost-effectiveness analysis. Section 5 involves sensitivity analysis for uncertainties that would potentially affect the projections made in economic evaluation. Discussions are provided in Section 6. Section 7 concludes the study.

2. Literature Review

Studies show that tobacco use is a global public health problem and the risk of initiating this habit is extremely high, especially among young people. Adolescents' social environment, including the functions, meanings, and images of smoking conveyed through cigarette advertisements, sets the stage for adolescents to initiate using tobacco (Elders, 1997). College students constitute a high-risk group in terms of engaging in risky behaviors such as smoking (Farajat, et al., 2011; Poscia, et al., 2015). College students are also at high risk of initiating and continuing to smoke because they are more likely to be exposed to their smoking peers (Hossain, et al., 2017). A study found that college students who consumed alcohol and had at least one parent with a college education were more inclined to initiate smoking compared to those who abstained from alcohol and whose parents had not attended college (Staten, et al., 2007). In a study conducted in Colombia, the reasons for initiating smoking during college years were examined (Afanador, et al., 2014) and college social environment and being away from one's hometown were found to have increased the risk of initiating smoking. Therefore, people who are more exposed to these risky behaviors by starting college and socializing are at greater risk of initiating tobacco products and intervention programs for young people who are at higher risk of initiation are of great importance.

The effectiveness of visual and digital materials in attitude and behavior change has been studied extensively. Visual and written materials used to develop health-related educational practices, positive behaviors, stereotyped attitudes, and existing information about a problem, and to gain desired knowledge-attitudes and behaviors are very effective (Tekbaş, et al., 2005). While the recall capacity of oral trainings after 3 days is 10-20%, the recall capacity is 65% in training using visual materials. 83% of what people learn is provided by sight, 11% by hearing, 3.5% by smell, 1.5% by touch, and 1% by taste (Kılıç, 1997). Individuals recognize visual stimuli, distinguish them, and interpret them by combining them with their previous experiences. In visual perception, the messages that need to be conveyed with the help of visual language are shaped in the minds of people clearly and understandably and can have purposeful meaning. Especially in messages used for social purposes, visual language cannot only create striking images but also increase the memorability of the audience (Ehses, 1984). Rhetoric, which is the art of saying something in a new way, is discussed in new ways through methods such as metaphor, simile, pun, comparison, exaggeration, and satire (irony) (Ehses, 1984). In explaining a situation, it is better to put many words in a short and concise way. Placing visual ideas in another image or images with similar or different images and interpreting or combining them increases the effectiveness of the given message.

When creating a visual idea, an effective communication process should be established in which more cognitive effort is made than the plain meaning dimension of the language in which the individual's attention is drawn before influencing the person and conveying their messages. In these images, meanings are conveyed in serious, satirical, ironic, or amusing ways. Including double meanings regarding the message to be conveyed in these images constitutes the main point of visual ideas (Heller and Vienne, 2012). Visual messages inform, attract attention, and encourage thought. However, textual information and logos that use visual cues in a clear manner that tries to persuade the target audience to make positive behavior changes by offering a motivating approach provides an effective transfer. At this point, the educational materials

prepared by including individuals in a visual problem-solving process together with direct educational messages enable individuals to be transformed from being only the recipients into participants in the meaning-making phase. Poster and brochure images created with visual puns will increase the permanence of memory (Çeken, 2016).

While tobacco usage remains as a significant problem, efforts to eradicate it may be less costly than thought. A review of economic evaluations of tobacco control programs found that these interventions are generally cost-saving or highly cost-effective (Kahende, et al., 2008). For instance, the California Tobacco Control Program resulted in substantial benefits, including over 700,000 person-years of life saved and over 150,000 person-years of treatment averted (Miller, et al., 2010). This shows that tobacco prevention policies and programs among youth are greatly worth their costs (Leão, 2017). In other words, increased tobacco prevention policies are effective in reducing overall tobacco consumption and prevalence of tobacco use, and improving public health (Chaloupka, et al. 2010).

3. The Intervention

The economic evaluation conducted in this study is based on the tobacco initiation prevention project implemented at one of the public universities in Ankara, Türkiye, during 2021-2023. The project consisted of six intervention applications involved 6 short thematic videos (20 seconds each), message posters (200 counts, 6 themes, 100 cm x 70 cm, placed in visible campus locations), educational seminars, message banners, on-demand psychological counseling, and events. These project activities and applications were tailored around five college-relevant themes of health, economics, academics, friendship, and family.

The project aimed to create a comprehensive anti-tobacco environment among the campus communities by adopting a multi-faceted approach and utilizing various communication channels. This holistic approach not only aimed to prevent the initiation of tobacco use among university students, but also contributed to improving students' awareness of tobacco by promoting a culture of health and well-being on campus. Evaluating the effectiveness of interventions is of great importance for the development of necessary policies.

4. Methodology

The objective of this study is to obtain the unit costs of prevented initiation and awareness for the intervention project mentioned above. CEA is one of the best approaches for achieving this objective as CEA can help decision-makers to achieve the best outcomes under the scarcity of resources. CEA is a valuable tool for systematically comparing the costs and outcomes of different interventions (Drummond et al. 201, Gold, 2018). CEA is a widely used research method to ensure the best use of resources in, for example, public transit systems (Nelson, 1979), education (Levin, 2003), and healthcare (Gold, 2018). It aims to compare the costs and outcomes of different treatment or intervention options to determine the most effective and economical one. In CEA, factors such as the cost of different treatment methods, the effects/benefits provided and the ratio of these effects/benefits to costs are taken into account. However, there is a need for standardized methods and transparency in these analyses to ensure their quality and comparability (Gold, 2018). O'Neill (1966) provides methods and formats for conducting and presenting cost-effectiveness studies.

Implementing CEA requires examining a carefully defined problem, collecting, and analyzing appropriate data. First, the treatment or intervention options to be compared are identified and the costs of each option are collected. Next, an appropriate metric is identified to measure the benefits of each option. Finally, a cost-effectiveness ratio is calculated by comparing the cost of each option with the effects it generates. This analysis helps ensure the most efficient use of resources and provides guidance to decision-makers on budget allocations and policy development.

Study differentiates between the sample CER and student-population-extrapolated CER as population-level estimations as well as sample-level estimations provide useful scale-up economic information about interventions.

The costs and effects data for the CEA conducted in this study have been obtained through project cost calculations and student surveys conducted post-intervention. As the first step of the CEA, the following project costing has been completed:

4.1. Project Costing

Costs are common elements of economic evaluation studies as costs are compared to project or program consequences. In addition to informing about relative cost-effectiveness ratios (CERs), understanding the costs associated with each project intervention campaign or activity enables stakeholders to assess the efficiency of resource allocation and identify areas for potential cost savings or optimization. Therefore, the calculation of project costs is essential for CEA. In this study, with a simplifying assumption, the project budget allocated by the project funder was taken as project costs. Under this assumption, the project cost is ₺525,871 (₺1,298,242.83 at June 2023 prices using the Turkish Central Bank's inflation calculation methodology). Short videos as project intervention campaigns were shown using the university's digital kiosks and TV screens at no charge. However, scale-up or replication of the project campaigns will require the purchase or renting of digital kiosks and TVs. In addition to project funding, we included the cost share of digital kiosk screens and TVs, calculated as ₺8,877.16. Thus, the total project cost is ₺1,307,119.99 at September 2023 prices.

The costs of each project intervention campaign or activity are also useful for the determination of relative CERs. The following table provides the costs of material and services and project personnel labor share by project campaign, activity, or event:

Table 1: **Costs of Project Campaigns, Activities, and Events**

Campaign application	Count	Material and services (₺)	Project personnel labor share (₺)**	Total cost (at 2023 September prices, ₺)
Posters	208	15,181.92	44,693.46	59,875.38
Short videos	6	103,339.88*	38,307.78	141,647.66
Tarpaulins	2	7,557.02	6,385.68	13,942.70
Booth (pen, brochure, tablecloth)	2,500	4,970.16	12,771.36	17,741.52
Orientation seminars	4	0.00	25,540.00	25,540.00
TOTAL		**131,048.98**	**127,698.28**	**258,747.26**

Note: Negligible items such as transportation expenses have been ignored.
*₺29,500 for video demonstration (market research, September 2023 prices) including digital kiosk display (alternative) cost (3 years expected economic life, 9 months/year usage, 25% use for the project, and 5% capital cost annualized).
**Assuming 25% of the staff budget is allocated to campaign development. It is assumed that 30% of the allocated share is spent on developing banners, 30% on video, 10% on tarpaulins, 10% on booths, and 20% on orientation.

4.2. Cost-Effectiveness Analysis (CEA)

In conducting CEA, it is crucial to determine the specific project outcome effects, which serve as the measures of effectiveness. These effects represent changes, resulting from project interventions, in natural magnitudes of project effectiveness measures. In this study, we adopted two measures of effectivenesses, message recall as a proxy for awareness and prevented initiation, for the CEA calculations. The recall effect pertains to the extent to which the target audience remembers and retains the information conveyed through the intervention activities, such as videos, seminars, and posters. On the other hand, the counts of prevented initiation reflect the tangible impact of the project in deterring individuals, particularly college students, from initiating tobacco use. Both recall and prevented initiation information were obtained from self-reports of respondents to post-intervention surveys. By analyzing these effectiveness measures alongside the associated costs, the CEA provides valuable insights into the effectiveness and impact of the intervention strategies implemented within the project. This

comprehensive evaluation facilitates informed decision-making and resource allocation for future initiatives aimed at tobacco initiation prevention and similar public health endeavors.

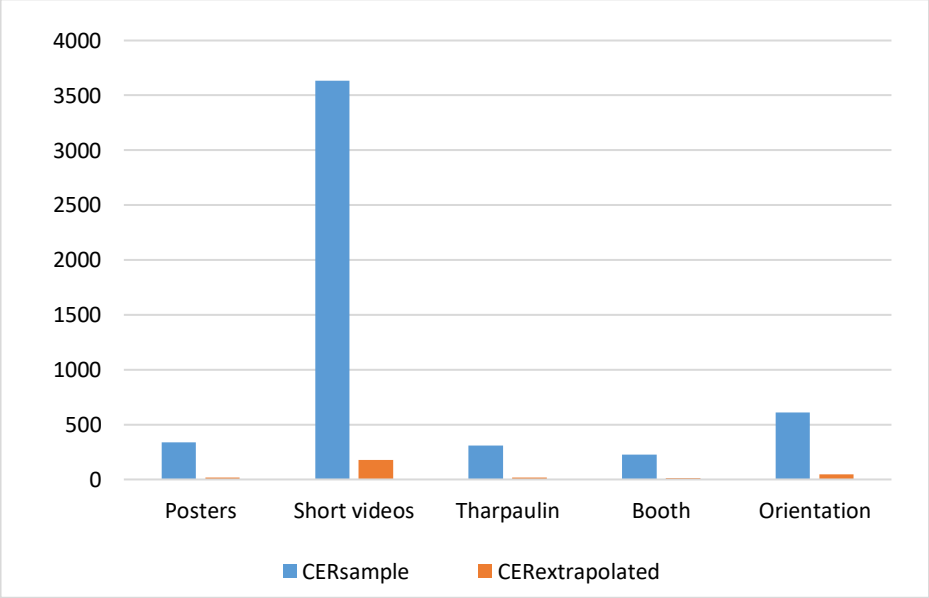
Table 2, Figure 1, and Figure 2, show the quantities of effects (recall and prevented initiation) and sample-level and population-level CERs for the effects.

Table 2: **Project Effects and CERs**

Campaign applications	Effects (sample)		CER_{sample}		$CER_{extrapolated}$	
	Recall	Prevented initiation***	Recall	Prevented initiation	Recall	Prevented initiation
Posters	176	75.55	340.20	792.53	16.78	39.08
Short videos	39	8.97	3.631,99	15,791.27	179,11	778.73
Tarpaulins	45	13.4	309.84	1,040.50	15.28	51.31
Booth (stand, gift pen, brochure, tablecloth)	78	12.2	165.63	1,454.22	11,22	71.71
Orientation seminars	42	10.9	608.10	2,343.12	46.63	115.55
TOTAL	**380**	**121.02**	**680,91**	**2,138.05**	**34,96**	**105.44**

The interventions generated total of self-reported 380 recalls and approximately 121 self-reported prevented initiations. While the sample-level CER for recall was ₺680,91 and for prevented initiation was ₺2,138.05, the extrapolated CERs were ₺34,96 and ₺105.44, respectively. For recalls, the most cost-effective intervention item is booth (stand, gift pen, and brochure, etc.), while the least cost-effective (highest CER) campaign item is the short video. For prevented initiation, the most cost-effective campaign tool was posters, while the campaign tool with the lowest cost-effectiveness (highest CER) was again short videos. Regarding CER for prevented initiation, it should be noted that since more than one answer could be given to the intervention effectiveness questions, the sample averaged when there was feedback that more than one campaign element was effective in not initiating.

Figure 1: **Relative CERs of Intervention Campaigns (Based on Awareness Generated)**

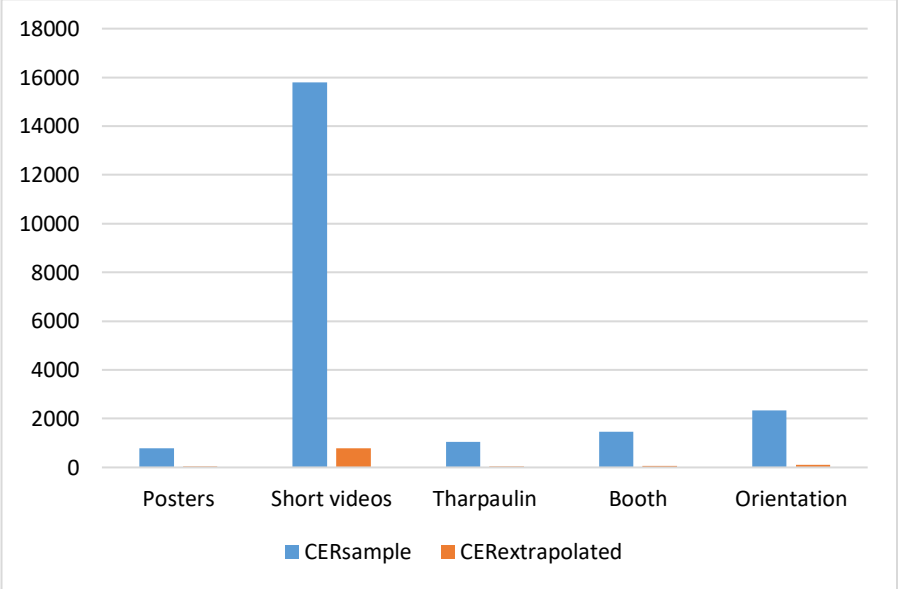


As shown in the figure 1, for recall effect both on the sample and extrapolated levels, short videos have the highest CERs while booth have the lowest CERs.

As shown in the figure 2 for prevented initiations both on the sample and extrapolated levels, short videos have again the highest CERs while booth have the lowest CERs.

Responses to a cross-check survey question that directly asked about project effectiveness indicated that 571 never-smoked students reported that they did not initiate tobacco products because of project applications that they were exposed to. Thus, considering the 571 prevented initiations at the extrapolated (campus) level, the project cost-effectiveness ratio (CER) is ₺2,289.18 (= ₺1,307,119.99 / 571), which means that the cost of each prevented initiation is ₺2,289.18.

Figure 2: **Relative CERs of intervention campaigns (relative to prevented initiation)**



5. Sensitivity Analysis

The results of the CEA conducted here are subject to reasonable uncertainties on both the costs and the effects side. For example, most of the project service purchases, such as video production and poster design, were outsourced from university resources, which may not be comparable to real market conditions. Especially the cost of video production remained below the market prices due to the fact that the videos were commissioned by the Department of Visual Communication of the AYBU Faculty of Architecture. On the other hand, rising inflation in Türkiye after project finalization also makes the cost findings of the study very conservative. Therefore, project costs must be adjusted upward.

CEA effect findings are based on student self-declared recall and prevention information during post-intervention surveys. We conducted a secondary and short cross-check survey using the university's electronic registration system (OBS) to measure the effects of the project. The project survey and the OBS survey indicated very close counts, 402 and 740, respectively, of prevented initiation. We adopted the average of the two, 571, as the prevented initiation.

6. Discussion

Starting university and university life has its own risk factors that may lead to tobacco use. (Demir, et al. 2024). Although the costs of the implemented project seem to be conservative as the project mostly utilized public sector services to produce videos and development of posters, banners, and messages to be delivered, this project shows that prevention of tobacco initiation of college students is possible at a reasonable unit cost.

In today's world, short thematic videos are considered among the best digital media behavior change tools. However, short videos have been found to be the least cost-effective campaign item in this study. The reason why short videos have the highest CER in terms of both awareness

and prevented initiations may be due to the relatively high costs of producing and displaying short videos. Also, relative to posters and other campaign items, longer video watching times might have lowered the effect counts of videos and thus lowered their cost-effectiveness. However, it should be noted that while it is costly to show short videos in closed circuit on campus physical spaces, publishing them on social media will increase cost-effectiveness (reduce CER). In order to prevent infiltration in the inter-campus control-trial mechanism design of the project, the videos were only shown in 4 physical spaces on campus. Therefore, exposure to social media will bring significant improvement in the cost-effectiveness of short videos.

Scale-up of this project to a nationwide level may require more professional and more private market purchases of media services. However, since a scale-up will mean implementation at all universities and colleges nationwide, unit costs will still be relatively low that so the Turkish Higher Education Council (YÖK) should consider scaling up tobacco initiation intervention like the project conducted.

7. Conclusion

This study conducted a CEA of a 27-month project that aimed to prevent college students from initiating tobacco products. Recall and prevented initiation were chosen as the two-evaluation metrics for the CEA conducted. Project interventions generated total of sample-level self-reported 380 recalls and approximately 121 self-reported prevented initiations. Given these, while the sample-level CER for recall was ₺680,91 and for prevented initiation was ₺2,138.05, the extrapolated CERs were ₺34,96 and ₺105.44, respectively. Responses to a cross check pots-intervention survey question that directly asked about project effectiveness indicated that the project potentially prevented 571 students at the extrapole (sample to student population) level. Considering this count of presented initiation, the project's CER is ₺2,289.18 (=₺1,307,119.99 / 571), which is quite similar to the extrapolated survey CER for prevented initiation. This means that the cost of each prevented initiation is ₺2,289.18. While the booth was the most cost-effective campaign tool for recall, as an indicator of project awareness, posters were the most cost-effective campaign tool for the prevented initiation. These findings will be crucial for replicating the project in similar settings or for scaling it up for nationwide application decisions. Future research must investigate whether spending ₺2,289.18 for each prevention is worth considering the expected benefits (cost savings) from the prevented initiation.

In light of the findings from this CEA, policymakers should consider allocating resources towards implementing and scaling up similar tobacco initiation prevention projects across universities nationwide. Given the significant impact demonstrated by the project in preventing tobacco initiation among college students, investing in similar interventions could yield substantial long-term benefits for public health and healthcare cost savings. Additionally, policymakers could explore partnerships with governmental agencies, non-profit organizations, and private sector entities to secure funding and support for replicating and expanding successful prevention initiatives. Furthermore, integrating comprehensive tobacco control measures into broader public health policies and programs can further enhance the effectiveness of prevention efforts and contribute to reducing the overall burden of tobacco-related illnesses in the population. By prioritizing tobacco prevention strategies and leveraging the insights gleaned from this CEA, policymakers can advance evidence-based policymaking and strengthen efforts to create tobacco-free environments for college students and communities nationwide.

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