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Effect of Public Broadcast on Public Knowledge of Preconception Folic Acid Towards Birth Defect Prevention in Malaysia

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ABSTRACT

Health promotion is essential for influencing behaviour change to prevent birth defects and achieve the Sustainable Development Goal of reducing neonatal and under-five mortality by 2030. Public broadcasting has the potential to deliver health messages widely, particularly in underserved communities, but evidence from interrupted time series (ITS) studies remains limited. This study aims to evaluate the impact of public broadcast interventions on knowledge of preconception folic acid intake for birth defect prevention in Malaysian using an interrupted time series (ITS) design. This study used an ITS design. Data were collected fortnightly at six time points over 12 weeks from 2,832 adults aged 18–64 years, recruited via convenience sampling. Participants were equally divided between an intervention group in Kelantan (n = 1,416), where targeted radio and television messages were broadcast, and a control group in Terengganu (n = 1,416), which received no intervention. Knowledge was measured using a standardised questionnaire. Segmented regression analysis showed a descriptive increase in mean knowledge scores post-intervention in the intervention group. However, no statistically significant changes were observed in trend (slope change = 0.0006) or level (intercept change (<– 0.01) between pre- and post-intervention phases. While statistical significance was not achieved, the findings indicate that public broadcasting is a promising medium for large-scale health promotion, capable of reaching broad audiences and addressing knowledge gaps. These results provide baseline evidence for designing future national-level broadcast interventions, which may require longer exposure periods or intensified messaging to achieve significant and sustained improvements in public health knowledge.

INTRODUCTION

Birth defects, also known as congenital anomalies, are a significant public health concern impacting millions of newborns and families worldwide, leading to substantial healthcare costs and long-term disabilities. Globally, they are a major cause of neonatal mortality and morbidity, ranking as the fourth leading cause, with about 12.6% of neonatal deaths attributed to them

annually (Toti et al., 2024; Tajuddin and Yusof, 2020; WHO, 2020). The widespread occurrence of birth defects is a pressing public health issue, compounded by varying levels of awareness and knowledge regarding preventive measures, especially the critical role of preconception folic acid (FA) intake (Begashaw, Tariku, and Berhane, 2022; Crider et al., 2022). FA plays a crucial role in preconception health, particularly in reducing the risk of neural tube defects (NTDs) during early fetal development (Al-Mohaithef et al., 2021).

The World Health Organization (WHO) recommends that pregnant women consume at least 400 μg of FA daily to prevent neural tube defects (WHO, 2022). While traditional promotions, such as leaflets and posters, are still frequently used as health education methods (Hasanica et al., 2020), birth defects unfortunately persist in Malaysia. Approximately 1 in every 33 (3%) babies is born with a serious birth defect annually (Zakaria et al., 2017). Studies indicate that very few childbearing women are likely to follow this recommendation (Tajuddin and Yusof, 2020; Yasmin et al., 2022). The poor perception of FA consumption among pregnant women highlights a critical gap in public health messaging that preconception care aims to address for birth defect prevention. Such efforts are crucial for meeting Malaysia's targets under Sustainable Development Goals 3 and 2 by 2025, specifically by focusing on birth defect prevention and improving maternal and child health through initiatives like early detection and management (Ministry of Health Malaysia, 2020).

Health promotion is essential for influencing behaviour change to reduce birth defects and achieve the SDG targets for child mortality by 2030 (WHO, 2022). Public broadcasting, including radio, can play a key role in delivering health education to marginalised communities (Odekina, 2016; Winnicott, 2016). As suggested by Bernal, Cummins, and Gasparrini (2018), an ITS design is a suitable approach for evaluating the impact of public health promotion interventions. However, the effectiveness of these strategies in driving behaviour change and clarifying pregnancy risks is not well established. Despite its potential to bridge information gaps and improve maternal and fetal outcomes, research—particularly using interrupted time series (ITS) designs to evaluate broadcasting's impact on health knowledge—is scarce. Therefore, this study aims to examine the impact of public broadcast interventions on public knowledge of preconception folic acid for birth defect prevention in Malaysia, utilising an ITS design.

METHODS

An ITS study was conducted among the rural population in northeast Peninsular Malaysia from October 2017 to June 2018. ITS is a valuable quasi-experimental study design in healthcare, particularly for evaluating the impact of interventions on outcomes over time (Hatageka et al., 2020). This population was selected because rural communities are often considered vulnerable due to factors such as limited access to resources, economic hardship, and social isolation, which make them more susceptible to various challenges. The intervention group comprised participants from a community market in Kelantan. Public participation was open, and Kelantan was chosen for its location as a rural northeast Peninsular state (Department of Statistics Malaysia, 2021). Eligibility criteria included participants aged 18 to 64 of both genders. Individuals aged 65 and above were excluded due to the relatively high incidence of hearing problems in this age group (National Institute on Deafness and Other

Communication Disorders, 2022). Exclusion criteria were physical or mental disabilities, diagnosed hearing problems, family members with birth defects, and individuals working as retailers or wholesalers in the community market. The control group consisted of participants from a nearby community market in Terengganu, also a rural state with similar characteristics.

Concerning sample size for ITS studies, there is no single exact formula to calculate the minimum sample size or the precise number of data points required. Instead, it is recommended to consider various factors collectively. These include the distribution of data points before and after the intervention, data variability, the magnitude of the expected effect, and the potential presence of confounding factors. These elements can significantly affect the validity of the findings (Bernal, Cummins and Gasparrini, 2018). Therefore, our sample size determination was based on a comprehensive consideration of these factors.

In this study, six data time points, both before and after the intervention, were applied. Thus, a maximum of six missing time points were allowed within the pre- and post-intervention periods. A target sample size of 100 participants per data point was established across six data points. Consequently, a total of 2832 participants were recruited using convenience sampling, with 1416 assigned to the intervention group (Kelantan) and 1416 to the control group (Terengganu).

The knowledge survey questionnaire, developed in English, drew upon existing literature (Ahmad et al., 2013; Abdulmalek, 2017; Tang et al., 2017; Kim et al.,2018). It was structured into three distinct sections: A, B, and C. Section A gathered socio-demographic data, including age, gender, marital status, ethnicity, highest educational level, and monthly household income. Section B assessed participants' knowledge of preconception FA in birth defect prevention. This section comprised seven items, each requiring a response on a three-point Likert scale: "True," "False," or "Don't Know." Scoring was set at three points for "True," two points for "Don't Know," and one point for "False." Additionally, reverse scoring was applied to two negatively phrased questions (Questions 6 and 7). Section C evaluated the effectiveness of the public broadcast intervention and participants' self-reported knowledge after listening to the broadcast. This section contained five statements, with responses recorded on a 5-point Likert scale (5=Very effective; 4=Effective; 3=Not sure; 2=Not effective; 1=Very not effective). Scores from Sections B and C were summed. A participant was deemed to have good knowledge and to perceive the public broadcast intervention as effective if their total score for each respective section exceeded half of its maximum possible points.

Ensuring linguistic and conceptual equivalence is crucial (Brislin, 1970). In Malaysia, a multicultural nation, utilising dual languages—English and Bahasa Malaysia in the survey questionnaire—is vital for effective communication across diverse communities. Four independent expert reviewers (an obstetrician, a paediatrician/neonatologist, a psychologist, and a nursing lecturer) fluent in both English and Malay checked and validated the translated version of the questionnaire. Discrepancies between the survey tool and the back-translation were discussed, and the finalised version of the instrument was subsequently utilised.

A pilot test was performed with 24 members of the public who met comparable inclusion criteria but were not included in the final sample analysis. A Cronbach's α of 0.74 was obtained, indicating good item reliability (Izah, Sylva and Hait, 2024; Taber, 2018). The Kaiser-Meyer-Olkin (KMO) test was also employed to measure sampling adequacy (Kaiser, 1974). The

measure was 0.894, which indicates a good sample size for analysing construct validity using factor analysis. The factor loading range for knowledge was 0.682 to 0.828. The survey, completed within ten to fifteen minutes, was answered by all participants, suggesting no need for clarification or refinement in the wording.

The intervention utilised a 2-minute broadcast script titled "My Best Mother-in-law," developed in both English and Malay. The research team, along with a nursing matron, a paediatrician/neonatologist, a community medicine lecturer, and a nursing lecturer—all with over 20 years of clinical experience and fluency in both languages—edited the script. This script featured a conversation between a mother-in-law, her son, and her daughter-in-law, discussing preconception FA consumption and its benefits in preventing birth defects. The audio was recorded in Malay, the local language, by an amateur dubbing professional from the Department of Broadcasting, Kota Bharu.

The pre-intervention phase ran from October to December 2017. During this time, the two-minute broadcast was aired fortnightly, every hour between 8 a.m. and 2 p.m. at the community market, and five times daily on Radio Television Malaysia in Kota Bharu. Data was not collected from January to March 2018. The post-intervention phase was evaluated at six data time points from April to June 2018, using a self-administered questionnaire. The purpose of this design was to compare outcome measures obtained at six data points before and six data points after the intervention's introduction to assess its effectiveness. The goal was to detect whether the broadcast intervention had an effect greater than the underlying trend.

Ethical approval for this study was obtained from the Universiti Sains Malaysia (USM) Human Research Ethics Committee (USM/JEPeM/15030083). The study adhered to the Declaration of Helsinki and institutional requirements. All participation was voluntary. To ensure confidentiality and anonymity, no information regarding participants' identities was collected, and completed consent forms and responses were stored separately. Coded numbers were used throughout the data collection process for enhanced anonymity and confidentiality.

All data were analysed using the Statistical Package for the Social Sciences (SPSS) software. Specifically, SPSS version 27.0 for Windows (SPSS Inc., Chicago, Illinois, USA) was used for data analysis. Descriptive statistics, including frequencies, percentages, measures of central tendency, dispersion measures, mean, and standard deviation, were employed to summarise the data. An ITS analysis was utilised to assess the impact of the public broadcasts. Segmented regression was employed to identify trends in changes caused by the intervention and to observe gradual changes over time. For all analyses, a p-value of ≤0.05 was considered statistically significant.

RESULTS

A total of 2,832 participants took part in the ITS study, with 1416 in the intervention group and 1,416 in the control group. The mean age across both groups was 35.20 years (SD=11.49). The majority of participants were Malay (99.1%), female (66.1%), and married (70.2%). Most had a secondary school education (67.1%), and their monthly household incomes ranged between MYR 1,001 and MYR 2,000 (USD 225.45 to USD 445.68), accounting for 43.3% of the participants.

Table 1 presents the baseline preconception folic acid knowledge scores for both the intervention group in Kota Bharu and the control group in Terengganu, alongside all pre- and post-intervention results. The mean knowledge score for the pre-intervention group was 12.99 (SD=5.32), which increased to 17.00 (SD=4.07) for the post-intervention group. In contrast, the control group showed little change, with a pre-intervention mean knowledge score of 16.36 (SD=2.67) and a post-intervention score of 16.44 (SD=2.47).

Table 1. Baseline Preconception Folic Acid Knowledge Scores for Intervention and Control Groups (Pre-and Post-Intervention)

Knowledge	Pre (n=708)	Post (n=708)	Mean difference	*p-Value*
	Mean (SD)	Mean (SD)		
Intervention Group (n =1416)	12.99 (5.32)	17.00 (4.07)	1.73	<0.001*
Control Group (n=1416)	16.36 (2.67)	16.44 (2.47)	0.08	0.577

*Statistically significant

Table 2. General Linear Regression of Associated Factors of Knowledge Scores of Intervention Groups on Preconception Folic Acid in Birth Defect Prevention in the Pre-Intervention Phase (n=708)

Variables	Univariable		Multivariable	
	b[a] (95% CI)	*p-Value*	b[b] (95% CI)	*p-Value*
Age (Years)	-0.016 (-0.049, 0.017)	0.345		
Gender				
Male	0	-	0	-
Female	3.313 (2.527, 4.099)	<0.001*	3.150 (2.410, 3.890)	<0.001*
Marital Status				
Single	0	-	0	-
Married	3.085 (2.160, 4.011)	<0.001*	2.860 (21.978 3.743)	<0.001*
Divorced	2.916 (1.018, 4.813)	0.003*	3.326 (1.529, 5.124)	<0.001*
Education Level				
Low (Primary school)	0	-	0	-
High (Secondary/ Tertiary education)	3.358 (2.049, 4.668)	<0.001*	3.580 (2.342, 4.819)	<0.001*
Monthly Household Income (MYR)	0.0011 (0.0007, 0.0014)	<0.001*	0.0007 (0.0003, 0.0010)	<0.001*
Ethnicity				
Malay	0	-		
Chinese	-0.397 (-3.728, 2.933)	0.815		
Others	0.003 (-10.462, 10.458)	>0.95		

[a] Crude regression coefficient
[b] Adjusted regression coefficient
Forward multiple regression method was applied. Model assumptions are fulfilled.
No multicollinearity was detected. There were no interactions among independent variables.
Coefficient of determination (R^2) = 0.202
*Statistically significant

Table 2 presents the general linear regression analysis of factors associated with knowledge scores in the intervention group during the pre-intervention phase. Univariable analysis revealed that gender, marital status, education level, and income were significantly associated with knowledge scores. Female participants exhibited higher knowledge scores than males (P < 0.001). Married participants also showed higher knowledge scores compared to single or divorced participants. Furthermore, those with higher education levels and participants with higher income levels demonstrated a greater increase in knowledge scores.

The multivariable analysis similarly indicated that gender, marital status, education level, and income were significantly associated with participants' knowledge scores. This analysis also revealed a strong correlation between married and divorced individuals. The forward multiple regression method was applied, and all model assumptions were fulfilled. No multicollinearity was detected, and there were no interactions among the independent variables. Therefore, the model explained 20.2% of the variation in the knowledge score.

Table 3. Baseline Knowledge Scores by Intervention and Control Groups Pre- and Post-Intervention

Knowledge Scores	Pre (n=708)	Post (n=708)	Mean difference	*p-Value**
	Mean (SD)	Mean (SD)		
Intervention Group	12.99 (5.32)	17.00 (4.07)	4.01	<0.001
Control Group	12.91 (4.63)	14.25 (5.14)	1.34	<0.001

*p≤0.05 was considered to be statistically significant

Table 3 illustrates the baseline knowledge scores for both the intervention and control groups, comparing their performance before and after the intervention. While descriptive statistics show an increase in knowledge scores for both groups, the intervention group demonstrated a more substantial increase than the control group.

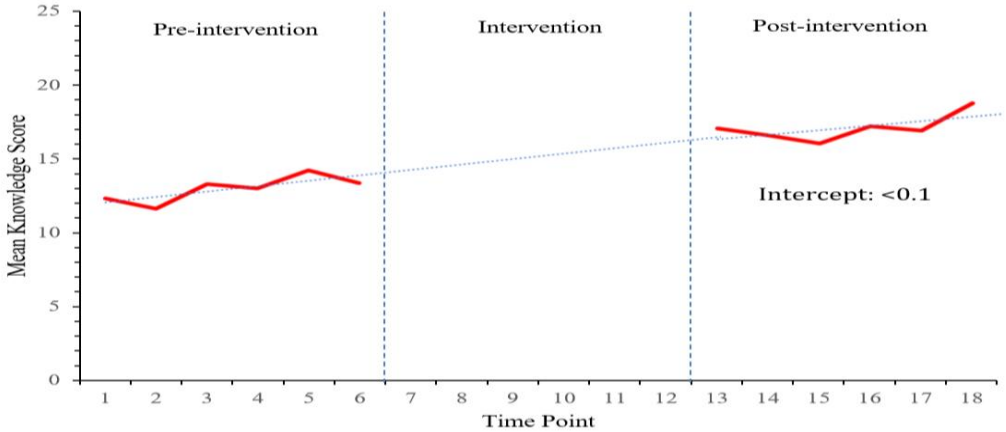

Figure 1. ITS Analysis of Pre- and Post-Intervention Knowledge Scores of Intervention Group

Absolute effects:

At 2 weeks, estimate of effect = 1.531 (95% CI: 0.781, 2.281), p=0.017
At 4 weeks, estimate of effect = 1.363 (95% CI: 0.131, 2.595), p=0.035
At 6 weeks, estimate of effect = 1.195 (95% CI: -0.179, 2.569), p=0.079
At 8 weeks, estimate of effect = 1.027 (95% CI: -0.536, 2.590), p=0.164
At 10 weeks, estimate of effect = 0.860 (95% CI: -0.928, 2.648), p=0.293
At 12 weeks, estimate of effect = 0.692 (95% CI: -1.342, 2.726), p=0.447

Figure 1 displays the ITS analysis graph for the intervention group, showing an increasing trend in pre-intervention knowledge scores compared to the control group. Post-intervention, the regression line indicates a small incremental increase in scores, reflected by a minor intercept in the interrupted time series.

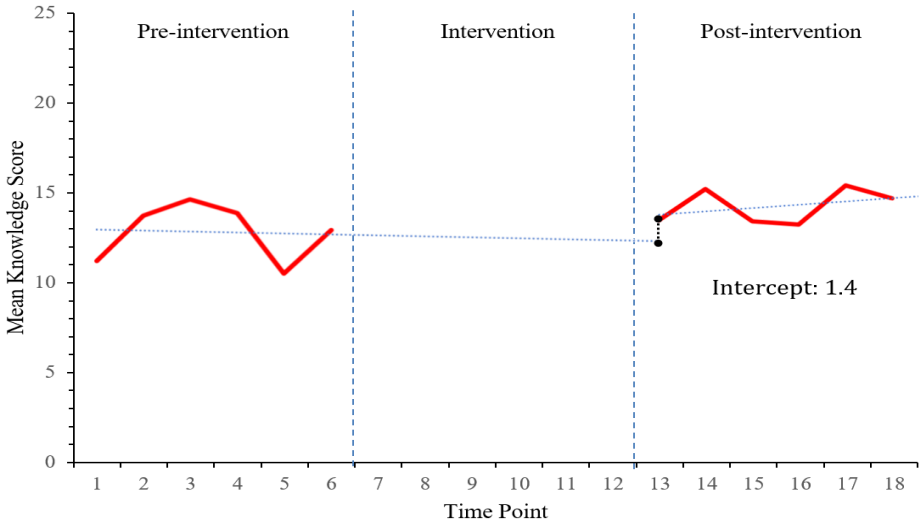

Figure 2 ITS Analysis of Pre-and Post-Intervention Knowledge Scores of Control Group

Absolute effects:

At 2 weeks, estimate of effect = 1.384 (95% CI: -2.600, 5.368), p=0.439
At 4 weeks, estimate of effect = 1.687 (95% CI: -2.581, 5.955), p=0.381
At 6 weeks, estimate of effect = 1.990 (95% CI: -2.791, 6.771), p=0.358
At 8 weeks, estimate of effect = 2.292 (95% CI: -3.170, 7.754), p=0.354
At 10 weeks, estimate of effect = 2.595 (95% CI: -3.662, 8.852), p=0.359
At 12 weeks, estimate of effect = 2.898 (95% CI: -4.227, 10.022), p=0.368

Figure 2 shows the ITS analysis graph for the control group's knowledge scores, both before and after the intervention. The graph revealed a notable reduction in knowledge scores at data point five, reflected by a downward regression line during the pre-intervention period. This downward regression line subsequently resulted in a higher intercept value for the control group compared to the intervention group's intercept value. However, this observed change in score was not statistically significant.

DISCUSSION

We conducted the ITS analysis to help determine whether the intervention using public broadcasting changed the trend of the knowledge measure. We observed positive changes in participants' knowledge regarding preconception FA for birth defect prevention. However, we found no significant difference between pre-and post-intervention trends or time series intercepts. A plausible explanation for this lack of statistical significance could be that outliers may have biased the pre-intervention data (Kwak and Kim, 2017), suggesting a need for additional data points and more participants per data point in future studies.

Our findings contrast with two previous Malaysian studies that utilised an audio clip intervention. Those studies reported a significant increase in knowledge, suggesting that audio clip interventions might be a suitable and effective mode of health education for perinatal issues (Asmalini, 2014; Faidzan, 2014). A likely explanation for the differing results is that the key difference lies in the scope and delivery method. An audio clip intervention is typically a short, targeted message. Our public broadcast intervention represents a broader, longer communication strategy that utilises a public broadcasting platform. Another plausible explanation for this discrepancy might be due to the public's limited retention of information provided by broadcasts in public areas, possibly exacerbated by the noise from busy activities in the community market that could have interfered with participants' ability to retain information. Furthermore, effectively conveying the message to the public may require a longer public broadcast duration. Therefore, a longer duration for public broadcasts may indeed be beneficial for knowledge retention, as it allows for more time to process and absorb information, leading to better recall.

This study has notable strengths, particularly its use of ITS analysis, which provides novel evidence in this research area, and its demonstrated good reliability. Despite these strengths, our study has several limitations. The research was conducted in a rural Malaysian state, making it uncertain whether the findings are generalisable to other populations. In the study's locations, Kelantan and Terengganu, Malays constitute 95% of the population. Overrepresentation of a single race in a study is a significant limitation, leading to biased results, reduced generalizability, and potentially hindering equitable healthcare and research outcomes. This can result in treatments that may not be equally effective for all groups and can perpetuate harmful stereotypes (Polit and Beck, 2024). Future research should include a broader range of ethnic groups to ensure fair representation across all communities. Additionally, most participants were female, under 40 years old, had secondary education, and reported monthly household incomes between MYR 1,000 and MYR 2,000 (approximately USD 225.45 to USD 450.91). Another limitation is the lack of existing ITS studies specifically evaluating the impact of public broadcast interventions on knowledge and underlying trends within the general public.

Our study highlights the need for further investigation into the association between income and preconception FA use. The observed lack of a significant increase in knowledge suggests that longer-duration audio clip broadcasts might be necessary for public health campaigns to be more effective. The discrepancy between awareness and actual folic acid use could also be attributed to unplanned pregnancies, warranting further exploration. Therefore, qualitative research is crucial to enhance our understanding of the importance of preconception FA intake in preventing birth defects in Malaysia. Additionally, future research should explore strategies for improving adherence to folic acid recommendations, especially since supplementation is often recommended conceptually rather than preconceptionally. The findings from such studies will be vital in guiding future research and improving FA information dissemination, as addressing the high incidence of preventable birth defects in Malaysia is an urgent public health priority that needs to be tackled in the 21st century.

CONCLUSION

It can be concluded that public broadcasts can effectively serve as a form of mass communication in health promotion. ITS analysis in this study revealed improved knowledge trends regarding preconception FA in birth defect prevention, offering valuable insights for future intervention studies involving national-level public broadcasts.

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