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Investigating Access to Reproductive Health Services Using GIS: Proximity to Services and the Use of Modern Contraceptives in Malawi

Nathan J Heard¹, Ulla Larsen¹ and Dairiku Hozumi¹

¹The Department of Population and International Health, Harvard School of Public Health, Boston, Massachusetts, USA.

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Abstract

This paper attempted to identify whether access to reproductive health services partly explains use of modern contraception in Malawi. Recent changes in Malawi's population policy have brought the state's population ambitions into alignment with the consensus reached at the International Conference on Population and Development held in Cairo in 1994. Concurrently, Malawi witnessed a large increase in the use of modern contraceptives from 7% in 1992 to 26% in 2000. A geographic information system (GIS) was employed to integrate health facility data from the Malawi health facilities inventory and global positioning data from the 2000 Malawi demographic and health survey. An effort to detect a plausible causal pathway was made by using distance to health services as a proxy variable for access to services. In a multivariate logistic regression analysis, after controlling for background variables traditionally associated with use of modern contraception, access could not be shown to explain use of modern contraception in Malawi. (*Afr J Reprod Health* 2004; 8[2]: 164-179)

Key Words: Reproductive health, family planning, contraception, integration, distance, GIS, Malawi

Résumé

Etude sur l'accès aux services de la santé de reproduction à l'aide du SIG: proximité aux services et l'utilisation des contraceptifs modernes au Malawi. Cet article a tenté d'établir si l'accès aux services de la santé de reproduction explique en partie l'utilisation de la contraception moderne au Malawi. Grâce à des modifications récentes dans la politique démographique, les ambitions de la population de du pays vont maintenant dans le sens du consensus auquel on a abouti à la Conférence Internationale sur la Population et le Développement qui a eu lieu au Caire en 1994. En conséquence, l'utilisation des contraceptifs au Malawi a connu une grande hausse au Malawi en passant de 7% en 1992 à 26% en l'an 2000. Les données de services de santé tirées des inventaires des infrastructures médicales au Malawi et les données des dispositions globales tirées de l'enquête démographique et de santé ont été intégrées à l'aide d'un Système d'Information Géographique (SIG). Nous nous sommes tâché de détecter une voie causale plausible en considérant la distance aux services de santé comme un variable de procuration pour l'accès aux services. En nous basant sur l'analyse de la régression logistique multifactorielle, ayant contrôlé pour les variables de fond traditionnellement liés à l'utilisation de la contraception moderne, il n'a pas été possible de montrer que l'accès peut expliquer l'utilisation de la contraception moderne au Malawi. (*Rev Afr Santé Reprod* 2004; 8[2]: 164-199)

Introduction

In Malawi, use of modern contraception has increased substantially. The 26% of currently married women using a modern method found in the 2000 Malawi demographic and health survey (MDHS) represents a large increase from the 7% recorded in 1992.¹ This contraceptive prevalence is also high when compared to the prevalence in countries that border Malawi.²

The increase has taken place in the context of major changes in government's approach to family planning and reproductive health. Ross and Stover's index of family planning programme effort shows that Malawi's family planning programmes have improved markedly in the areas of policy, service, evaluation and availability. As a percentage of the maximum index score, Malawi increased in each year of 1989, 1994 and 1999, from 16 to 44 and 50% respectively.³

As late as 1969, modern family planning was banned from government hospitals.⁴ In 1984, access to contraception was finally introduced to Malawi in an organised fashion. Even then, access was widened only for the expressed purpose of spacing pregnancies for married women.⁵ In 1996, Malawi liberalised family planning by removing limitations on use by women of specific parity or age.⁶

In 1994, at the International Conference on Population and Development (ICPD) at Cairo, Malawi endorsed what became known as the Cairo Consensus. The conference sponsored by the United Nations Population Fund (UNFPA) showcased a comprehensive, holistic, rights-based and client-centered approach to health in all matters related to the reproductive system. At the conference, Malawi's representative announced government's intention to implement this brand of reproductive health care programme.⁷

Vertical family planning programmes were roundly criticised as being relics from an era of population control and failing to meet the myriad health needs of people, especially women. To replace the vertical mode, integrated services designed to meet a variety of reproductive-related health needs were offered. Integrated services can include safe motherhood, child survival, reproductive tract infection (RTI) and sexually transmitted infection (STI) treatment, and youth-friendly capacity, among other services.

Just prior to ICPD, Malawi introduced a population policy consistent with this model.⁸ The notion of reproductive health was intentionally broad, an explicit contrast to the view that family planning should be programmed in isolation. For many people, programmatically isolated family planning still symbolises the abuse of rights that has characterised many population policies in the past.^{9,10}

Advocates of integration hoped that health synergies would arise. For example, some barrier methods of contraception offer dual protection against unintended pregnancy and STI infection. The client-centered approach promised to address a wider range of health issues. With the rapid spread of HIV in many parts of the world, the idea that clients of family planning could be afforded some protection against infection was profoundly attractive.

There is an active debate on whether the call to reproductive health can be justified by empirical evidence. In 2004, a decade after Cairo, criticism of reproductive health as an organising principle for health services is growing especially around the lack of data supporting the existence of synergistic health effects.¹¹⁻¹³

Whether population policies that increase the availability of reproductive health services, including family planning, affect contraceptive use is also a matter of debate. Various factors such as gender relations, social structure, perceived quality of services, perceived risk of use, educational levels and age have been shown to affect the desire and ability of women to use modern methods of contraception.¹⁴⁻¹⁸ In part, this debate hinges on whether the costs of contraception, such as physical barriers to contraceptive access, have any effect on contraceptive use.

Because the Malawian government's population policy is at least partially motivated by a desire for a slower growing population rather than health alone, the quality of client-provider relations could be worse at government clinics. Joint research by the University of Southampton and UNFPA suggests that quality of care is at least a concern at government clinics. Providers even shout at the women, so most women go to paying hospital where there is better care, otherwise at our government hospitals all they do is shout and shout so the women just return (without a method).¹⁹

The extent to which access to family planning explains contraceptive use is not well understood. Physical access to family planning services is a necessary but not sufficient precursor to a woman's use of modern contraception. Near proximity represents practical access, meaning low

cost in terms of time and energy. This is not meant to discount the reality of psychological, monetary or social costs.

However, Coale's three pre-conditions for the use of modern contraceptives; that the idea be within consciousness, there be perceived advantageousness, and availability, might all be affected by near proximity to facilities that offer services.²⁰ Therefore, it is plausible that increased availability of modern methods would increase use, reduce unmet need for contraception and decrease the number of unintended pregnancies. It is with this assumption that distance is used as a proxy for access to services.

If physical access does not explain modern contraceptive practices, then expanding the availability of modern contraceptives may do little to serve the needs of Malawian women and thereby prove to be an inefficient use of scarce health resources. Conversely, evidence that access to family planning increased the likelihood of use would support a programme that focused on the strategic placement of new clinics.

Using geographic information systems, researchers have generated accessibility indicators based on Euclidean distance to services, travel time and poverty measures.²¹⁻²³

Some research has found that time, distance and subjective perceptions of accessibility do not play an important role in contraceptive use.¹⁷ Similar findings have been found regarding unmet need for contraception.²⁴ However, research specific to Malawi suggests that low utilisation rates were associated with lack of access to modern methods in the past.²⁵ Others have found more general evidence that access, as measured by reported proximity to a supply source, is positively correlated to modern contraceptive use.²¹

In this paper, we have sought to replicate this finding using a GIS in the analysis of demographic and health survey (DHS) data on contraceptive use in Malawi, using the 2000 MDHS and the Malawi health facilities inventory, a health facility enumeration conducted in 1997 and 1998 by a research team funded by the Japan International Co-operation Agency.²⁶ Variables that capture the distance from DHS sample clusters to health facilities were generated using a GIS.

Facilities that offer family planning were differentiated and compared to facilities that offer family planning in combination with other specific services, such as antenatal care or HIV testing. Combining these variables with the vast information captured in the 2000 MDHS provides the opportunity to analyse the relationship between contraceptive use, access indicators and various background characteristics.

This paper also provides a test for the integration of specific services. If access to family planning in conjunction with other specific services were associated with a higher likelihood of contraceptive use than family planning alone, promising policy options would emerge. The Malawi Department of Population Services might then have context-specific empirical evidence for using reproductive health as a health system organising principle.

Background

Malawi is a small southern African country with a population of 9.9 million. It is also among the world's least developed countries. Purchasing power parity for Malawi was 570 in international dollars, which ranked it 206th, or third to last, among countries for which data were available.⁴⁴ Based on a 1998 integrated household survey, the Gini coefficient was 0.52 in urban areas and 0.37 in rural areas.²⁷

Conditions associated with low use of modern contraceptives are widespread in Malawi. Focus groups of Malawian women have found that accurate knowledge about the use and side effects of contraceptive methods is poor. Two reports indicated typical misunderstandings: some say among every ten condoms one contains HIV virus already put, so if you pick that one it means you are infected, and that pills accumulate in the stomach and you can die from that.¹⁹

Educational attainment is low. According to Malawi's Ministry of Education, Science & Technology (MEST), the pupil to teacher ratio at the primary level is 62:1, the percentage of children that reach standard 8 is 20, and only 0.5% of Malawians aged 18-23 years are enrolled in tertiary education.²⁸

The social environment of women can also constitute a barrier to use of modern methods. Women may feel great pressure to bear children from their extended family. A recent qualitative study produced numerous complaints from women that their partners forced sex upon them. In the words of one woman:

My husband was not understanding and he did not like to abstain from sexual intercourse. As a result he beat me up all the time I refused him to have sex with me. I reported to the elders but all they advised me was to persevere. (Focus group discussion for middle-aged women, Rumphi).⁴

While knowledge of modern contraceptives (97%) is high, unmet need for family planning (30%) is also high. Total fertility in the Republic of Malawi is one of the highest in the world. Though declining, the average woman would have 6.4 children if subjected to current age-specific fertility. Total fertility in rural Malawi (6.7) is much higher than in urban centre (4.5). This is true at every five-year age interval. Total fertility does not vary greatly by region (North, Central, South). But it does vary substantially by district, with a total fertility spread of 3.1, with 4.3 in Blantyre and 7.4 in Mangochi.¹

Other reproductive health indicators are of great concern. Estimation of maternal deaths based on the 2000 MDHS sample produced a ratio of 1,120 maternal deaths per 100,000 live births.¹ MOHP estimated that of 676,250 pregnant women, 135,250, or approximately 20%, required management of complication from abortion.²⁹ In 1998, UNAIDS/WHO recorded from various sources a median HIV prevalence of 26% in pregnant urban women and 18% in pregnant rural women.³⁰

While fertility is declining somewhat, the Malawian government still views the birth rate with some alarm. Recently, the Department of Population Services acting deputy director, Grace Hiwa, said we cannot control population growth (as it were) but we put in place measures to ensure a balance between population growth rate and available natural resources.³¹

These measures have included a series of legislative initiatives that followed ICPD, including the implementation of a safe motherhood plan of action, a national youth policy, and a liberalisation of family planning services.⁶ Political momentum followed Malawi's participation at the five-year review of ICPD in 1999 as well. As part of the observance of International Women's Day 2000, Malawi launched a national gender policy.³²

Concrete extensions of policy include government's creation of family planning clinics, community-based distribution of family planning methods and the introduction of population education into the school curricula.

Data and Methods

Data

This study made use of two pre-existing datasets and new variables that were generated by combining these extant datasets in a GIS using ArcView GIS (version 3.2, ESRI) software. The Malawi health facilities inventory was used with permission from the Government of Malawi. The 2000 MDHS was also used by permission. Special permission was obtained to use the geocode contained within the 2000 MDHS.

USAID has conducted two DHS surveys in Malawi, one in 1992 and the other in 2000. The 2000 MDHS survey was large, with 13,220 women being interviewed in 560 clusters from a July to November 2000.¹ This survey was selected for its currency, representativeness and quality. Due to a high level professional and institutional expertise gained over many years of conducting these surveys, the quality of DHS surveys is generally accepted to be very high. The scope of the survey covers a wide range of questions regarding contraceptive practice, knowledge and perception.

The Malawi health facilities inventory, which provides the other dataset used in this study, included information on structural characteristics of buildings, human resources, available health care services, ownership and global positioning system (GPS) coordinates. All public, non-governmental and mission-operated facilities above health centre level, voluntary HIV counselling and testing centres, some private facilities, MOHP offices, and rehabilitation centres were included in this inventory. Detailed questionnaires were administered at 672 facilities.²⁶ Data were not available for the location of health posts or area covered by community-based family planning distributors and mobile clinics.

Because the research question was focused on use of modern contraception, a sub-population of women who have had sex and were not pregnant at the time of the survey was chosen for

this study. There were 10,291 such women in the 2000 MDHS survey. Concern that infecundity is difficult to determine with accuracy from survey questions led to the inclusion of the self-reported infecund. Similarly, of those women who were breastfeeding at the time of survey, many were using modern contraception, leading to their inclusion.

Since 1996, DHS surveys have included geocode, which allows users to analyse data spatially at the cluster level.⁴³ In order to protect the privacy of individuals, finer resolution is not available. It is not possible to locate specific individuals using DHS. Therefore, while unsuited for micro level analysis, DHS geocode offers immense promise for analysis at the district, national and regional levels. In 2003, forty one DHS surveys with geocoding were either available or ongoing.

The geocode contained within USAID's DHS efforts has been underutilised although examples of use do exist, such as McGuire's use of DHS geocode in the evaluation of food security in Sahelian Africa.³³ The authors agree with John Weeks that demographic research is moving inexorably from its long-standing pattern of spatial awareness to an increased appreciation for the value and utility of spatial analysis.³⁴

When read into a GIS using ArcView, one can locate DHS clusters on a map or learn what percentage of the DHS sample lives within a given distance of another geographical feature, such as a road or river. One problem with the 2000 MDHS geocode became apparent. When plotted on a map with other geographical features, 19 DHS clusters appeared within the spatial boundaries of Lake Malawi. Initially, this was thought to be a problem with the GPS. However, it was learned that the boundaries of Malawi were digitised from a paper map.³⁵ Therefore, the cluster locations were assumed to be correct.

Another concern was related to the area of the clusters. Because cluster centres are represented in the GIS as points, the measure of distance from clusters to other geographical features could be skewed if some clusters covered a large area while other clusters were relatively compact. However, it was assumed that DHS points were located closer to the settled area of the cluster area where the people live rather than the true geographical centre.³⁵

ArcView allows users to create variables that capture spatial relationships between different geographical features. In order to gauge access to facilities, the distance from individual clusters to the nearest facility that offers various services was measured in miles. This variable was generated as Euclidean distance, or miles as-the-crow-flies.

The choice of Euclidean distance was important and involved several assumptions. Topology can cause travel times between identical Euclidean distances to vary markedly. Obstacles such as mountains or forests could severely degrade the suitability of distance as a proxy for access.

Alternative methods of estimating access have been developed such as travel time estimates based on pathfinding algorithms or accessibility indicators based on poverty measures.²³

As part of the facility enumeration, substantial resources were devoted to studying the extent to which Euclidean distance would severely distort travel times to facility locations. Enumerators constructed ease-of-passage grids where each square was assigned an integer that estimated the difficulty of travel. They found that Euclidian distance was an adequate measure, but noted that this was specific to Malawi.³⁶ With few exceptions, Malawi is flat and easily traversed in any direction. Given this context, a different measure of access seemed unnecessary.

Using ArcView, eight variables that capture the distance in miles from each DHS cluster to the nearest facility that offered family planning in addition to specific services were generated and stratified into quartiles. These services included antenatal care, STI services, 24-hour services, youth-friendly services, HIV testing, HIV counselling, maternity services and immunisation. Distance to any clinic that offers family planning was also generated (Figure 1).

Other facility variables were utilised. These variables recorded the type of owner of the nearest facility that offers family planning and the number of services offered at that facility. Facility ownership data were used to explore possible links between use of modern contraception and whether a facility owner was public or private.

Distance and facility variables were then merged with the 2000 MDHS by cluster number in SAS v8. Each woman was thereby assigned a set of facility variables according to the cluster of which she was a part. Data analysis focused on whether the services offered by the nearest health facility are related to the likelihood that women use modern contraception. Analysis was conducted in three stages.

Methods

As a first stage of the analysis, the following back-ground variables were selected: age, parity, marital status, educational level, partner's educational level, exposure to media, exposure to family planning messages, ethnicity, religion, region, district, place of residence, sons who have died, daughters who have died, total children ever born, and who has final say on the respondent's health care. Theoretical considerations and availability determined a variable's selection for analysis. There is wide agreement that age, education, marital status and parity affect contraceptive use. Religion and ethnicity were included to capture cultural variation that may not be captured by district. Lastly, media exposure was included in acknowledgement of diffusion of innovation theory.^{37,38}

Bivariate tables were constructed and Pearson's chi-square tests conducted on each distance and background variable in relationship to use of modern contraception. The purpose was to gauge an initial measure of statistical association and to ensure those variables, and their stratifications contained sufficient numbers of women. Following DHS classification, modern contraception was interpreted to include the following methods: pill, intrauterine device (IUD), diaphragm/foam/jelly, condom, female sterilisation, male sterilisation, implants, lactational amenorrhoea and emergency contraception.¹

The second stage of the analysis employed a univariate logistic regression analysis of use of

modern contraception. Each variable that added significance at the 0.20 level or higher based on the likelihood ratio test in the univariate analysis was advanced to the multivariate analysis.

In the third stage, multivariate logistic regression models were estimated using backward selection at the 0.05 level of significance with use of modern contraception as the dependent variable and one distance variable in addition to background characteristics. Due to colinearity among the distance variables, the four distance variables significant at the 0.05 level were run in separate models.

Contingent upon the results of the multivariate analysis, interaction effects were to be considered. It seemed plausible that the distance variables might interact with facility ownership, frequency of listening to a radio, or whether a residence was urban or rural. It could have been that by itself, living near a facility exerts only a modest amount of influence on women's contraceptive habits while living near a facility in addition to frequent enjoyment of a radio exerts a great influence. A study of family planning service utilisation in Blantyre observed that only those with access to clinics and media would take advantage of services.³⁹

Results

Bivariate frequency distributions of the facility data revealed that the majority of distance variables were significantly associated with use of modern contraception using Pearson's chi-square test. Over 60% of the population lived within four miles of a health facility that offers family planning. The majority of the population also lived within four miles of health facilities that offered family planning and were open 24 hours a day. However, large portions of the population lived far away from some services. For example, approximately half of the sample population lived 11 miles or more from health facilities that offered youth-friendly family planning services.

Most health facilities closest to the DHS clusters (56%) were owned by the Ministry of Health or the local government. The two other large owners were the Christian Health Association of Malawi, a non-denominational health service provider, and Banja La Mtsogolo, the Marie Stopes partner in Malawi. Approximately 70% of the nearest health facilities offered six or more services (results not shown).

Bivariate frequency distributions also allowed a summary characterisation of the sample population. Of the 10,291 women sampled, 2,767 used modern contraception. The remaining 7,524 (73%) did not use modern contraception. Most respondents were married and had no education or had incomplete primary education. Residences were primarily rural. The most populous district was Blantyre. Christianity was the majority religion, with 84.0% of the population as followers, followed by Islam, 14.5% of the population. Only 1.5% of the sample reported none or another religion (results not shown).

Univariate logistic regression analysis showed that four of the nine distance variables were significant at the 0.05 level, namely, distance to facilities with family planning and youth-friendly services, distance to facilities with family planning and HIV testing, distance to facilities with

family planning and HIV counselling, and distance to facilities with family planning and 24-hour services (Table 1). With one exception, distance to family planning and another service was more highly associated with contraceptive use than distance to family planning alone. The exception was distance to facilities with family planning and immunization. Eight of the nine distance variables passed at the 0.20 level of significance. The owner of the facility also showed significance as did the number of services offered at the nearest health facility.

The findings in the univariate models were not replicated in the multivariate models. Of the four distance variables that were significant at the 0.05 level, none were retained in the multivariate models.

Model one shows that, when controlling for background characteristics, women who lived near facilities that offer family planning in addition to youth-friendly services were no more likely to use modern methods of contraception than women who lived further away from such facilities (Table 2).

The other variables derived from the GIS were not included the model. Neither the number of services offered at the nearest facility nor the owners of nearest facilities proved significant.

As expected, whether a woman's residence was located in an urban or rural area was significant. Women in rural areas were only 0.86 (0.75-0.98, 95% CI) as likely to use modern contraception as their urban counterparts.

Specific districts proved significant. The odds ratios indicated that women in all districts that showed significance had lower use of modern contraception in relation to Blantyre, an important commercial and industrial centre and home to one of the densest population concentrations in the country.

Models two, three and four were indistinguishable from model one. In fact, each distance variable responded very similarly in the presence of co-variables. As no variables of interest remained in the final multivariate models, no first order interaction was examined.

Discussion

Univariate analysis suggest that a health service plus family planning was more highly correlated with contraceptive use than the same health service without family planning. In addition, many individual services that were offered together with family planning had a higher association with use of contraception than family planning alone. However, while greater distance from some services corresponded with a slight decreasing likelihood of use of modern contraception, likelihood actually increased with distance from some services. In other words, although many distance variables were significantly correlated with use of modern contraception, odds ratios were not readily interpreted.

Multivariate logistic regression analysis revealed that when controlling for background variables

that serve as proxy for socio-economic status, household dynamics and women empowerment, these health facility distance effects disappear entirely.

Proximity to family planning was not associated with use of modern contraception, when socio-economic, demographic and other background characteristics were controlled. Proximity to components of reproductive health, such as youth-friendliness or maternal and child health services were also not associated with use of modern contraception. Evidence from previous studies that access as measured by reported proximity to a supply source is positively correlated to modern contraceptive use could not be replicated.

Of all the distance variables, youth-friendliness initially appeared to be strongest. This was not surprising since young people are a particularly underserved population in sub-Saharan Africa.⁴⁰ Youth-friendliness in clinics addresses issues of service that are particularly important to young people. These include affordability, confidentiality and the involvement of youth and other important representatives of the community. Health workers are often trained to provide counselling and refrain from judging clients who seek family planning.⁴¹ In short, youth-friendliness initiatives target the removal of several key barriers to access that inhibit young women and men from seeking or maintaining a contraceptive method.

The removal of social and logistic barriers could be expected to benefit members of a community other than the targeted age group. Improvements in quality of service would prove attractive to women of all ages and expose many women who eschew modern methods to accurate information that is thoughtfully communicated. That being said, it is important to note that 37% of the sample was under the age of 25 years. Malawi is a young country. A successful programme that caters for youth would have the potential to reach many people.

Health planners and supporters of service integration know, of course, that not just any number or combination of services would result in the hoped-for synergies. Intuition supports the argument that many services would increase use of modern contraceptives when combined with family planning. Health care workers might readily suggest the use of a barrier method in conjunction with treatment for STIs. Delivery of maternity service also seems like an appropriate time to raise the issue of contraception to ensure that women are informed of means to space or limit future pregnancies. However, neither distance to facilities with family planning and STI services nor distance to facilities with family planning and maternity services showed a significant effect. Our results were unable to support the intuition that reproductive health synergies exist in Malawi.

Other results of interest were found. Qualitative research conducted by others has revealed that quality of service at government clinics was driving some women to seek family planning at clinics that charge fees for service.¹⁹ However, when compared to facilities owned by the Ministry of Health and Population, this study showed that other owners of the nearest facilities that offer family planning were not appreciably different. It is possible that women are avoiding private facilities due to resource constrain and public facilities due to poor service, with the same effect lower than optimal contraceptive use.

Lastly and unexpectedly, when husbands were the sole decision-makers on how many children the couple should have, partners were more likely to use modern contraception. This also held true when others, assumed to be members of an extended family, have sole decision-making authority. Neither husbands nor members of the immediate family appeared to constitute a barrier to use. Other background characteristics revealed effects that were consistent with expectations.

Conclusion

In this study, the geocode of the 2000 MDHS was combined with facility data to test two hypotheses:

1. Physical proximity to health service facilities that offer family planning would be positively associated with use of modern contra-ceptives.
2. The effectiveness of the integration of services advocated by supporters of reproductive health could be measured and vindicated.

The first hypothesis received weak confir-mation from univariate logistic regression analysis. Proximity to any service in addition to family planning was almost always more significant than the service alone. However, multivariate analysis showed that when controlling for background characteristics, neither distance nor health facility characteristics were significant. Therefore, evidence to support the second hypothesis could not be captured.

A plausible explanation is that community-based health workers, health posts and mobile clinics are successfully distributing modern contraception to women who desire it but do not have access to facilities of the health centre level or larger. If this were the case, those women who in this study were far from larger facilities that offer family planning services may have access through other channels. Modern contraceptives could be pervasive enough in Malawi to nullify any spatial effect.

Future studies could investigate possible links between proximity to health facilities and contraceptive method choice. For example, women living near a health facility that offers a broad array of contraceptive options may be more likely to adopt a temporary family planning method. Should women live so far from family planning resources that short-acting contra-ceptives are inconvenient, their choice may be biased towards long-acting contraceptive methods such as sterilisation or injection. It could then be argued that service capacity is not meeting the need of Malawian women to have a sufficient array of method options.

There is interesting precedent of spatial analysis in research on contraceptive method choice.⁴² Even if women are able to obtain modern contraceptives in remote areas, they may lack access to an appropriate range of methods.

This study examined a simple relationship: distance from individual DHS sample clusters to

individual health facilities. Future studies could investigate a possible relationship between use of modern contraception and density of health facilities surrounding DHS clusters by determining the number of facilities within a five-mile buffer.

Lastly, the failure to find evidence for service integration synergies could have resulted from the particular methodology employed in this study. Perhaps couples near HIV and STI services are more likely to use male or female condoms, a method that offers protection against unwanted pregnancy as well as infections. Another study might focus on non-pregnant women who are current users of modern contraception and who received antenatal care prior to their last birth to probe the effectiveness of this outreach point.

This study showed that geocode in DHS surveys can be used for both planning and evaluation of health programmes. Health planners in Malawi could use this study's methodology as part of a resource allocation decision-making process. The newly released 2000 MDHS and a 2000 Malawi census provide an opportunity to explore in more detail an understudied country at a critical juncture. Government has shown a sincere eagerness to implement a population policy informed by the Cairo consensus. This study represents an early effort to document the effects of Malawi's radical population policy change on the adoption of modern contraceptive use.

Malawi only recently made the large policy shift that enabled the establishment of a coordinated family planning programme. Government's embrace of family planning is relatively recent and seems to correspond with an increase in contraceptive use. However, increased access does not seem to be the driving force of the change in contraceptive practice.

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Table 1 Odds Ratios and Confidence Intervals from Univariate Logistic Regression Models of Sexually Active, Non-pregnant Women who Use Modern Contraception by Health Facility Characteristic (N = 10,291)

	N	OR	95% CI	p-value ¹
<i>Distance to facilities with family planning services (miles)²</i>				
< 1.89	2563	1.00		0.0981
≥ 1.89 and < 3.31	2570	1.10	(0.97–1.24)	
≥ 3.31 and < 4.97	2573	1.13	(1.00–1.28)	
≥ 4.97	2585	1.16	(1.03–1.31)	
<i>Distance to facilities with family planning and HIV testing services (miles)</i>				
< 4.98	2569	1.00		0.0019
≥ 4.98 and < 9.96	2547	1.02	(0.90–1.15)	
≥ 9.96 and < 15.51	2590	1.20	(1.06–1.36)	
≥ 15.51	2585	1.06	(1.06–1.35)	
<i>Distance to facilities with family planning and HIV counselling services (miles)</i>				
< 3.60	2370	1.00		0.0135
≥ 3.60 and < 7.36	2423	0.97	(0.86–1.10)	
≥ 7.36 and < 11.28	2483	0.94	(0.83–1.06)	
≥ 11.28	3015	0.83	(0.74–0.94)	
<i>Distance to facilities with family planning and STD services (miles)</i>				
< 1.95	2573	1.00		0.0963
≥ 1.95 and < 3.41	2545	1.03	(0.92–1.17)	
≥ 3.41 and < 5.25	2593	1.08	(0.96–1.22)	
≥ 5.25	2580	1.16	(1.03–1.32)	
<i>Distance to facilities with family planning and youth-friendly services (miles)</i>				
< 5.44	2570	1.00		< 0.0001
≥ 5.44 and < 11.29	2549	1.07	(0.95–1.21)	
≥ 11.29 and < 19.46	2579	1.22	(1.08–1.37)	
≥ 19.46	2593	1.35	(1.19–1.53)	
<i>Distance to facilities with family planning and maternal services (miles)</i>				
< 2.12	2572	1.00		0.0789
≥ 2.12 and < 3.51	2558	0.99	(0.88–1.12)	
≥ 3.51 and < 5.50	2582	1.11	(0.99–1.26)	
≥ 5.50	2579	1.12	(0.99–1.26)	
<i>Distance to facilities with family planning and antenatal services (miles)</i>				
< 1.97	2562	1.00		0.0943
≥ 1.97 and < 3.42	2572	1.04	(0.92–1.17)	
≥ 3.42 and < 5.23	2561	1.10	(0.97–1.24)	
≥ 5.23	2596	1.16	(1.13–1.31)	
<i>Distance to facilities with family planning and immunization services (miles)</i>				
< 1.94	2565	1.00		0.2075
≥ 1.94 and < 3.37	2568	1.05	(0.93–1.19)	
≥ 3.37 and < 5.04	2581	1.10	(0.98–1.25)	
≥ 5.04	2577	1.13	(1.00–1.28)	
<i>Distance to facilities with family planning and 24-hour services (miles)</i>				
< 2.30	2560	1.00		0.0027
≥ 2.30 and < 3.92	2586	1.14	(1.01–1.30)	
≥ 3.92 and < 7.29	2571	1.19	(1.06–1.35)	

	2560	1.14	(1.01–1.30)
≥ 3.92 and < 7.29	2571	1.19	(1.06–1.35)
≥ 7.29	2574	1.25	(1.10–1.41)

¹Likelihood ratio χ^2 test; ²Distance in quartiles

Source: 2000 Malawi Demographic and Health Survey.¹

Table 2 Odds Ratios Confidence Intervals from Multivariate Logistic Regression of Sexually Active, Non-pregnant Women who Use Modern Contraception by Background Characteristics (N = 10,291)

	First model		Second model		Third model		Fourth model	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
<i>Distance to facilities with family planning and youth friendly services (miles)</i>								
< 5.44	1.00							
≥ 5.44 and < 11.29	1.00	(0.88–1.14)						
≥ 11.29 and < 19.46	0.97	(0.85–1.12)						
≥ 19.46	0.94	(0.82–1.09)						
<i>Distance to facilities with family planning and HIV testing (miles)</i>								
< 4.98			1.00					
≥ 4.98 and < 9.96			1.01	(0.89–1.16)				
≥ 9.96 and < 15.51			0.92	(0.80–1.06)				
≥ 15.51			0.94	(0.82–1.08)				
<i>Distance to facilities with family planning and HIV counseling (miles)</i>								
< 3.60					1.00			
≥ 3.60 and < 7.36					1.02	(0.89–1.16)		
≥ 7.36 and < 11.28					0.96	(0.84–1.11)		
≥ 11.28					0.90	(0.78–1.03)		
<i>Distance to facilities with family planning and twenty-four hour services (miles)</i>								
< 2.30							1.00	
≥ 2.30 and < 3.92							0.93	(0.82–1.06)
≥ 3.92 and < 7.29							0.92	(0.81–1.05)
≥ 7.29							0.93	(0.80–1.07)
<i>Place of residence</i>								
Urban	1.00		1.00		1.00		1.00	
Rural	0.86	(0.75–0.98) *	0.86	(0.75–0.98) *	0.84	(0.74–0.97) *	0.85	(0.74–0.98) *
<i>District</i>								
Blantyre	1.00		1.00		1.00		1.00	
Karonga	0.50	(0.38–0.66) ***	0.51	(0.39–0.66) ***	0.51	(0.39–0.66) ***	0.50	(0.39–0.65) ***
Kasungu	0.82	(0.64–1.05)	0.84	(0.66–1.08)	0.86	(0.67–1.10)	0.84	(0.65–1.08)
Lilongwe	1.01	(0.80–1.28)	1.03	(0.81–1.30)	1.01	(0.80–1.27)	1.01	(0.81–1.28)
Machinga	0.80	(0.61–1.04)	0.81	(0.62–1.06)	0.82	(0.63–1.07)	0.80	(0.61–1.05)
Mangochi	0.60	(0.45–0.81) ***	0.62	(0.46–0.82) **	0.62	(0.46–0.82) **	0.61	(0.45–0.81) ***
Mulanje	0.91	(0.72–1.15)	0.92	(0.73–1.16)	0.93	(0.73–1.18)	0.93	(0.73–1.17)
Mzimba	0.68	(0.53–0.87) **	0.69	(0.54–0.89) **	0.69	(0.54–0.89) **	0.68	(0.53–0.87) **
Salima	0.55	(0.42–0.72) ***	0.56	(0.42–0.73) ***	0.54	(0.42–0.71) ***	0.55	(0.42–0.73) ***
Thyolo	1.07	(0.84–1.37)	1.06	(0.83–1.34)	1.07	(0.84–1.36)	1.08	(0.85–1.38)
Zomba	0.66	(0.51–0.84) ***	0.66	(0.52–0.84) ***	0.66	(0.52–0.84) ***	0.66	(0.52–0.85) ***
All others	0.80	(0.65–0.97) *	0.80	(0.66–0.98) *	0.81	(0.67–0.98) *	0.80	(0.66–0.98) *
<i>Age group (years)</i>								
15–19	1.00		1.00		1.00		1.00	
20–24	1.56	(1.29–1.88) ***	1.55	(1.28–1.88) ***	1.56	(1.29–1.88) ***	1.56	(1.29–1.89) ***
25–29	1.53	(1.24–1.88) ***	1.52	(1.24–1.87) ***	1.52	(1.24–1.87) ***	1.53	(1.24–1.88) ***
30–34	1.06	(0.84–1.34)	1.06	(0.84–1.33)	1.06	(0.84–1.33)	1.06	(0.84–1.34)
35–39	0.92	(0.72–1.18)	0.92	(0.72–1.17)	0.92	(0.72–1.17)	0.92	(0.72–1.18)

35-39	0.92	(0.72-1.18)	0.92	(0.72-1.17)	0.92	(0.72-1.17)	0.92	(0.72-1.18)
40-44	0.60	(0.47-0.77) ***	0.60	(0.47-0.77) ***	0.60	(0.47-0.76) ***	0.60	(0.47-0.77) ***
<i>Current marital status</i>								
Currently married	1.00		1.00		1.00		1.00	
Never married	0.67	(0.33-1.34)	0.66	(0.33-1.33)	0.67	(0.33-1.34)	0.67	(0.33-1.34)
	First model		Second model		Third model		Fourth model	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Formerly married	0.75	(0.62-0.91)**	0.75	(0.62-0.91)**	0.75	(0.62-0.91)**	0.75	(0.62-0.91)**
<i>Children ever born</i>								
0-3	1.00	1.00	1.00	1.00				
4-5	2.05	(1.77-2.38)***	2.05	(1.77-2.37)***	2.06	(1.78-2.38)***	2.05	(1.77-2.38)***
6+	3.61	(3.05-4.28)***	3.60	(3.04-4.27)***	3.62	(3.05-4.28)***	3.61	(3.05-4.27)***
<i>Final say on number of children</i>								
Respondent	1.00	1.00	1.00	1.00				
Respondent + someone else	1.13	(0.81-1.58)	1.13	(0.81-1.58)	1.13	(0.81-1.58)	1.12	(0.80-1.57)
Someone else	1.41	(1.20-1.66)***	1.42	(1.20-1.67)***	1.41	(1.20-1.66)***	1.41	(1.20-1.66)***
Decision not made/NA	0.89	(0.72-1.12)	0.89	(0.72-1.12)	0.89	(0.71-1.12)	0.89	(0.71-1.11)
<i>Highest educational level</i>								
None	1.00	1.00	1.00	1.00				
Primary	1.39	(1.20-1.61)***	1.39	(1.21-1.61)***	1.39	(1.20-1.61)***	1.39	(1.21-1.61)***
Secondary and above	1.55	(1.22-1.96)***	1.56	(1.23-1.97)***	1.55	(1.22-1.96)***	1.55	(1.22-1.96)***
<i>Partner's education level</i>								
None	1.00	1.00	1.00	1.00				
Primary	0.87	(0.75-1.01)	0.87	(0.75-1.01)	0.87	(0.75-1.01)	0.87	(0.75-1.02)
Secondary and above	1.48	(1.30-1.69)***	1.48	(1.29-1.69)***	1.48	(1.29-1.69)***	1.48	(1.30-1.70)***
Don't know or missing (not married)	1.01	(0.53-1.91)	1.01	(0.53-1.92)	1.01	(0.53-1.92)	1.01	(0.53-1.91)
<i>Flooring material</i>								
Natural	1.00	1.00	1.00	1.00				
Finished	1.40	(1.23-1.60)***	1.41	(1.23-1.61)***	1.41	(1.23-1.61)***	1.40	(1.23-1.60)***
Other	1.15	(0.88-1.50)	1.15	(0.88-1.50)	1.15	(0.88-1.50)	1.15	(0.88-1.50)
<i>Religion</i>								
Catholic	1.00	1.00	1.00	1.00				
Other Christians	0.92	(0.82-1.03)	0.92	(0.82-1.03)	0.92	(0.83-1.03)	0.92	(0.82-1.03)
Muslim	0.75	(0.63-0.90)**	0.75	(0.63-0.90)**	0.76	(0.63-0.91)**	0.76	(0.63-0.91)**
No religion and other	0.50	(0.32-0.81)**	0.51	(0.32-0.81)**	0.51	(0.32-0.81)**	0.51	(0.32-0.81)**
<i>Exposure to media</i>								
Low	1.00	1.00	1.00	1.00				
High	1.17	(1.05-1.30)**	1.17	(1.05-1.30)**	1.17	(1.05-1.30)**	1.17	(1.05-1.30)**
<i>Exposure to family planning messages</i>								
Low	1.00	1.00	1.00	1.00				
High	1.17	(1.05-1.30)**	1.17	(1.05-1.30)**	1.17	(1.05-1.30)**	1.17	(1.05-1.30)**

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Source: 2000 Malawi Demographic and Health Survey

Figure 1 **Distance to Youth-Friendly Facilities that Provide Family Planning Services**