Did the Millennium Development Goal Target 7c (to halve between 1990 and 2015 the proportion of the global population without sustainable access to safe drinking water) Reduce the Prevalence of Diarrheal Illness in the Dominican Republic?

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Abstract

Research Question: Did the Millennium Development Goal Target 7c (to halve between 1990 and 2015 the proportion of the global population without sustainable access to safe drinking water) reduce the prevalence of diarrheal illness in the Dominican Republic?

Background: According to the World Health Organization, diarrheal illnesses are the ninth leading cause of death worldwide. Developing countries are at especially high risk due to the lack of quality infrastructure and the Dominican Republic is no exception. This study uses diarrheal illness as a surrogate for water purity in region.

Methods: This is a cross-sectional study that obtained data using the Demographic and Health Surveys Database. Census data from the Dominican Republic was obtained from 2002, 2007 and 2013. Prevalence of diarrheal illness was compared for the census years and odd ratios calculated for prior to and after the completion of the project in 2012.

Results: The study revealed a steadily increasing prevalence when participants were asked if they had, "Diarrhea within the last 2 weeks (2002: 15.6%, 2007: 16.5%, and 2013: 17.7%; p=0.03)." Before 2012, a total of 16.1% of participants reported that they had, "Diarrhea within the last 2 weeks", while after 2012, 17.7% of participants reported that they had (p=<0.0001). This resulted in an odds ratio of 1.23 (p=<0.0001) with the current water supply.

Conclusions: The Millennium Development Goal Target 7c did not reduce the amount of diarrheal illness in the Dominican Republic. The odds ratios of diarrheal illness were elevated when comparing prevalence prior to and after 2012, especially with water piped into dwelling and tanked in water.

Introduction

According to the World Health Organization, diarrheal illnesses are the ninth leading cause of death worldwide. Developing countries are at especially high risk due to the lack of quality infrastructure and the Dominican Republic is no exception. In 2012, the Dominican government celebrated as achieved the completion of the Millennium Development Goal Target 7c (to halve between 1990 and 2015 the proportion of the global population without sustainable access to safe drinking water). Our aim was to determine whether the initiative was successful at reducing the prevalence of diarrheal illnesses across the country.

Figure 1: DHS database utilized in study

Methods

This is a cross-sectional study that obtained data using the Demographic and Health Surveys Database. Census data from the Dominican Republic was obtained from 2002, 2007 and 2013. Since the Millennium Development Goal Target 7c was celebrated as complete in 2012, data from 2002 and 2007 censuses were used to compare the change in prevalence of diarrheal illness in the 2013 census data. Odds ratio values and 95% confidence intervals were then calculated to evaluate various demographics and outcomes.

Results

Census data from the Dominican Republic including the years 2002, 2007, and 2013 actually revealed a steadily increasing prevalence when participants were asked if they had, "Diarrhea within the last 2 weeks (2002: 15.6%, 2007: 16.5%, and 2013: 17.7%; p=0.03)." This increase was observed throughout the course of the Millennium Development Goal Target 7c, which began in 1990 and was celebrated as accomplished in 2012. Before 2012, a total of 16.1% of participants reported that they had, "Diarrhea within the last 2 weeks", while after 2012, 17.7% of participants reported that they had (p=<0.0001). This resulted in an odds ratio of 1.23 (p=<0.0001) with the current water supply. Other data that supports the poor state of the current water supply is the increased odds of having diarrhea when water is piped into the dwelling or brought in by a tanker, with odds ratios of 1.24 (p=<0.0001) and 1.11 (p= 0.043) when compared to a bottled water source respectively. Higher education decreased the odds of contracting diarrheal illness with an odds ratio of 0.77 (p=0.003). Secondary and higher education also decreased the risk of blood in the stool with odds ratios of 0.44 (p=0.01) and 0.45 (p=0.03) respectively.

Results Continued

Demographics

Variables	Overall N=26,225	2002 N=11,362	2007 N=11,149	2013 N=3,714	p-value
Respondent's Age, years (mean, 95% CI; N=26,225)	26.5 (26.5, 26.6)	26.4 (26.3, 26.5)	26.6 (26.5, 26.7)	26.7 (26.5, 26.9)	0.02
Respondent Highest Level of Education (%, 95% CI; N=26,225)					<0.0001
None	6.10 (5.82, 6.40)	6.28 (5.85, 6.74)	6.67 (6.22, 7.15)	3.87 (3.30, 4.54)	
Primary	47.4 (46.8, 48.0)	55.2 (54.3, 56.1)	44.2 (43.3, 45.1)	33.1 (31.6, 34.6)	
Secondary	32.2 (31.6, 32.7)	27.3 (26.5, 28.1)	34.7 (33.8, 35.6)	39.3 (37.8, 40.8)	
Higher	14.3 (13.9, 14.8)	11.1 (10.6, 11.8)	14.4 (13.7, 15.1)	23.7 (22.3, 25.1)	
Head of Household Age, years (mean, 95% CI; N=26,224)	38.3 (38.1, 38.4)	38.1 (37.8, 38.3)	38.5 (38.3, 38.8)	37.9 (37.6, 38.4)	0.01
Head of Household Gender (male, %; N=26,225)	73.1 (72.6, 73.6)	79.4 (78.6, 80.1)	70.3 (69.5, 71.2)	62.1 (60.5, 63.7)	<0.0001
Total Number in Household (mean, 95% CI; N=26,225)	5.32 (5.29, 5.34)	5.47 (5.42, 5.51)	5.26 (5.22, 5.30)	5.04 (4.97, 5.11)	<0.001
Household Marital Status (%, 95% CI; N=26,225)					<0.0001
Never Married	2.53 (2.34, 2.72)	2.07 (1.83, 2.36)	2.76 (2.47, 3.08)	3.23 (2.71, 3.85)	
Married	78.7 (78.2, 79.2)	81.7 (80.9, 82.3)	77.0 (76.2, 77.8)	74.8 (73.3, 76.1)	
Other	18.8 (18.2, 19.2)	16.2 (15.6, 16.9)	20.2 (19.5, 20.9)	21.9 (20.7, 23.3)	
Source of Water (%, 95% CI; N=26,212)					<0.0001
Bottled/Small Tank	44.1 (45.4, 46.7)	39.4 (38.5, 40.3)	45.1 (44.1, 45.9)	69.5 (67.9, 70.9)	
Surface water, spring, river, stream, or Well Water	7.01 (6.70, 7.32)	8.83 (8.32, 9.36)	6.56 (6.11, 7.03)	2.77 (2.29, 3.35)	
Rainwater	7.73 (7.41, 8.06)	9.26 (8.74, 9.80)	8.02 (7.52, 8.53)	2.18 (1.76, 2.70)	
Piped into Dwelling, Yard/Lot	30.1 (29.5, 30.7)	36.6 (35.7, 37.5)	28.7 (27.9, 29.6)	14.7 (13.6, 15.8)	
Tanker Truck /other	9.05 (8.71, 9.40)	5.93 (5.51, 6.38)	11.6 (11.0, 12.3)	10.8 (9.91, 11.9)	
Time Taken to get to the water source, minutes (mean, 95% CI; N=4,764)	20.2 (19.4, 21.0)	22.0 (20.7, 23.4)	19.4 (18.2, 20.5)	17.3 (15.4, 19.2)	<0.001

Kruskal Wallis Test to compare continuous variables. Chi-squared to compare categorical variables.

Table 1: Demographics assessed in the study

Outcomes

Variables	Overall N=26,225	2002 N=11,362	2007 N=11,149	2013 N=3,714	p-value
Diarrhea within the last 2 weeks, yes (%, 95% CI) (N=25,330)	16.3 (15.8, 16.7)	15.6 (14.9, 16.3)	16.5 (15.8, 17.2)	17.7 (16.5, 18.9)	0.03
Blood in Stool Sample, yes (%, 95% CI) (N=2,384)	7.88 (6.87, 9.04)	N/A	8.00 (6.82, 9.37)	7.56 (5.74, 9.89)	0.89
Place of Medical Treatment for Diarrhea (%, 95% CI) (N=3,634)					<0.0001
None/private	56.9 (55.3, 58.5)	67.1 (64.8, 69.3)	53.6 (51.3, 55.9)	0	
Public hospitals	34.2 (32.7, 35.8)	25.9 (23.9, 28.1)	34.5 (32.3, 36.8)	100.0	
Private hospitals	8.47 (7.61, 9.42)	6.71 (5.61, 8.01)	11.1 (9.75, 12.7)	0	
Both	0.44 (0.27, 0.71)	0.18 (0.06, 0.55)	0.74 (0.43, 1.28)	0	

Chi-squared to compare categorical variables.

Table 2: Prevalence of diarrhea and blood in stool. Participants responded yes or no to, "Diarrhea within the last 2 weeks." or "Blood in stool sample."

Association between Time and Diarrhea

Variables	Diarrhea within the last 2 weeks N=26,225 % (95% CI)	OR (95% CI)	p-value
Time period			
<2012	16.1 (15.6, 16.5)	REF	
>2012	17.7 (16.4, 18.9)	1.23 (1.11, 1.35)	<0.0001
Respondent's Age, years		0.95 (0.95, 0.96)	<0.0001
Respondent Highest Level of Education			
None		REF	
Primary		1.04 (0.89, 1.21)	0.58
Secondary		0.88 (0.75, 1.03)	0.11
Higher		0.77 (0.64, 0.91)	0.003
Head of Household Age, years		0.99 (0.99, 1.00)	0.99
Head of Household Gender (male)		1.04 (0.96, 1.13)	0.35
Total Number in Household		1.01 (0.99, 1.03)	0.21
Household Marital Status			
Never Married		REF	
Married		1.02 (0.82, 1.27)	0.85
Other		1.11 (0.88, 1.37)	0.37
Source of Water			
Bottled/Small Tank		REF	
Surface water, spring, river, stream, or Well Water		1.09 (0.95, 1.26)	0.22
Rainwater		0.94 (0.82, 1.08)	0.41
Piped into Dwelling, Yard/Lot		1.24 (1.14, 1.35)	<0.0001
Tanker Truck /other		1.14 (1.00, 1.29)	0.043

Logistic regression adjusting for all other variables within the model.

Table 3: Odds ratios for diarrhea calculated based on reported prevalence before 2012 and after 2012. Prevalence of diarrhea based on water sources and those odds ratios also calculated, using bottled water as a control. Odds ratios for education level, age, etc.

Results Continued

Association between Time and Diarrhea

Variables	Blood in Stool Sample N=2,384 % (95% CI)	OR (95% CI)	p-value
Time period			
<2012	8.00 (6.80, 9.37)	REF	
>2012	7.55 (5.74, 9.89)	1.03 (0.72, 1.47)	0.86
Respondent's Age, years		0.99 (0.97, 1.02)	0.56
Respondent Highest Level of Education			
None		REF	
Primary		0.66 (0.37, 1.20)	0.18
Secondary		0.44 (0.23, 0.83)	0.01
Higher		0.45 (0.22, 0.94)	0.03
Head of Household Age, years		1.00 (0.98, 1.01)	0.74
Head of Household Gender (male)		0.84 (0.58, 1.22)	0.36
Total Number in Household		0.98 (0.91, 1.06)	0.65
Household Marital Status			
Never Married		REF	
Married		0.89 (0.37, 2.14)	0.79
Other		0.87 (0.35, 2.16)	0.76
Source of Water			
Bottled/Small Tank		REF	
Surface water, spring, river, stream, or Well Water		0.94 (0.48, 1.86)	0.87
Rainwater		0.87 (0.43, 1.80)	0.70
Piped into Dwelling, Yard/Lot		1.10 (0.75, 1.60)	0.62
Tanker Truck /other		1.07 (0.65, 1.76)	0.78

Logistic regression adjusting for all other variables within the model.

Table 4: Odds ratios for blood in the stool. Odds ratios based on education level, age, etc.

Discussion and Conclusions

The Millennium Development Goal Target 7c was ineffective at reducing the prevalence of diarrheal illness in the Dominican Republic. In fact, the prevalence of diarrheal illness has increased throughout the course of the initiative. The increase was especially notable in populations that used water piped into dwellings and tanker truck water sources. This is precisely the water supply that the initiative set out to improve. Many Dominicans may have a false sense of security with the current water supply and need to be educated on safe water practices. Follow up studies are needed to determine if education is effective at reducing diarrhea prevalence in the region.

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