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Women in Egypt, Nigeria, and India can protect themselves from 'Gender-Based Violence' caused by avoiding high temperatures

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Abstract
This paper uses household survey data from Nigeria, Egypt, and India to study effects of hot temperatures on physical violence between husband and wife. Both surveys indicate a strong link between temperature and attitudes to Gender-Based Violence. Respondents tend to be more accepting of a man using physical violence against his wife if the interview takes place at a high temperature, compared to moderate temperatures; this tendency applies to both male and female respondents. This tendency may be due to the effects of stress hormones such as adrenaline and noradrenaline. Ownership of electric fans tends to reduce acceptance of violence; air-conditioning seems even more effective. If women are taught more about the thermal stress, they may be able to reduce their risk of violence.

KEYWORDS: Gender-Based Violence; attitudes; thermal stress; Egypt; Nigeria.

Introduction

This paper investigates domestic violence between spouses. This is often referred to as 'Intimate Partner Violence'; some writers use the term 'Gender Based Violence', implying that such violence is used by some men to maintain power over women (Bott, Morrison & Ellsberg, 2005: 3). This paper uses specific attitude data: views on men hitting women (neither of the two surveys used in this paper ask about attitudes to women hitting men), so the term Gender Based Violence (GBV) will be used.

Many researchers report links between extreme temperatures and violence. Van de Vliert et al (1999: 300) find there is more violence in hot climates, which they explain in terms of 'cultures of masculinity': in hot places, men are expected to be dominant, and women are expected to be subordinate. Simister & Cooper (2005) also report more violence in hot places, which they explain in terms of stress hormones such as noradrenaline. Kukkonen-Harjula et al, 1989, found more noradrenaline in blood of heat-stressed people; Haller, Makara & Kruk, 1998, claim noradrenaline causes aggression. Perhaps 'thermal stress' causes frequent aggression in hot areas, and frequent exposure to this aggression eventually seems normal (and hence acceptable) to people who observe it.

Researchers disagree on the effects of temperature on violence. Some writers, such as Van de Vliert et al (1999), report evidence of a 'curvilinear hypothesis': violence tends to increase with higher temperatures, up to a point (perhaps a daytime temperature about 24°C), but then declines with further increases in temperature. Simister & Cooper (2005) reach an opposite conclusion: that there is more violence at very hot temperatures. Despite such controversies, there are areas of agreement: over a range of roughly 8 to 24°C, both groups of researchers claim violence tends to increase if the temperature rises.

If violence is more common in hot climates, this may apply to domestic violence also. Domestic violence is a major problem in many countries (Martin et al, 2002).

Available data may underestimate the problem: prevalence rates should "be viewed with caution, as a sizable number of crimes against women go unreported due to social stigma attached to them" (NCRB, 2001 chapter 5: 3); IIPS and ORC Macro (2000: 78) make a similar warning about DHS data. Quantitative data from DHS could be complemented by qualitative research, in future research.

Delsol et al (2003: 637) claim husband-to-wife aggression is associated with attitudes condoning violence against a spouse. We may be able to understand domestic violence better, if we study attitudes to violence.

Data and methods

The 'Demographic & Health Surveys' are a series of a nationally representative household surveys. This paper uses the DHS Nigeria survey (NPC and ORC Macro, 2004). Fieldwork was carried out in 2003; it includes rural and urban households, in all 36 Nigerian states (NPC and ORC Macro, 2004: p. 212). This paper also uses data from the 1998-2000 DHS survey of India, one of the biggest household surveys ever collected: it covers urban and rural India, and is a nationally-representative survey of India. See IIPS and ORC Macro (2000) for details. I refer to it below as 'DHS India'.

In addition, this paper uses a study carried out by the Centre for Surveys & Statistical Applications, (University of Cairo), called WAS (Work, Attitudes and Spending). Fieldwork for WAS took place in December 2005, and March & July 2006 (2,161 and 415 and 2,428 cases). WAS (like DHS) includes both urban and rural households, and is a nationally representative sample – but WAS has a much smaller sample-size than DHS Nigeria, and the WAS sample includes only 7 out of 26 governorates. Respondents in DHS Nigeria were women aged 15 to 49, whereas WAS included all adult ages. The WAS sample only includes married respondents, so I limit DHS Nigeria samples to respondents married at the time of interview. About half of the WAS sample are men.

This paper studies respondents' attitudes to gender-Based Violence. Accepting domestic violence is defined as agreeing with the DHS question: "Sometimes a wife can do things that bother her husband. Please tell me if you think that a husband is justified in beating his wife in each of the following situations". WAS followed the DHS approach, asking if respondents agree with the following question: 'It's justified for a man to hit his wife, if she refuses to have sex with him'.

I estimate temperature in each part of Egypt and Nigeria, and in each month, using data from Weatherbase (2006). I use 'maximum' temperature, i.e. the average (for all available years) of the maximum temperature for that month and that weather station; and 'minimum' temperature, the average minimum temperatures at each station & month. This data source has limitations – for example, for interviews in January 2006, it would be better to use the January 2006 temperature rather than the average January temperature in recent years, if it is available. If there is more than one weather station in a governorate, I use the station in the largest town/city; for governorates with no weather station data in Weatherbase, I calculate the average of adjacent governorates. All temperatures in this paper are in degrees Centigrade (°C).

it is possible that the temperature at the time of interview may affect a respondent's attitudes; this temperature is estimated by using the following formula:

$$\text{Current temperature} = ((T_{max} + T_{min})/2) + ((T_{max} - T_{min})/2)*\sin(\pi*(H - 8)/12)$$

where T_{max} is the hottest temperature at that governorate & month;
T_{min} is the coolest temperature in that governorate & month;
H is the time of interview (using the 24-hour clock).

A sine wave is used to approximate hour-to-hour temperature variation. Consider, for example, a Cairo households interviewed in January: the above formula assumes a respondent interviewed at

2pm experienced T_{max} (the maximum Cairo temperature recorded in January in recent years); if anyone were interviewed at 2am, they'd be expected to experience T_{min} (the minimum January Cairo temperature, averaged over recent years). For someone interviewed at 8am or 8pm, the temperature estimate is exactly halfway between T_{min} and T_{max}. I assume the maximum temperature is 2pm (not noon, when the sun is overhead, because homes retain heat); Malinda Anthony (2002: p. 14) found the hottest indoor temperature about 3pm to 5pm in the case of hospital buildings, but there will tend to be less thermal inertia in smaller buildings, or outdoors.

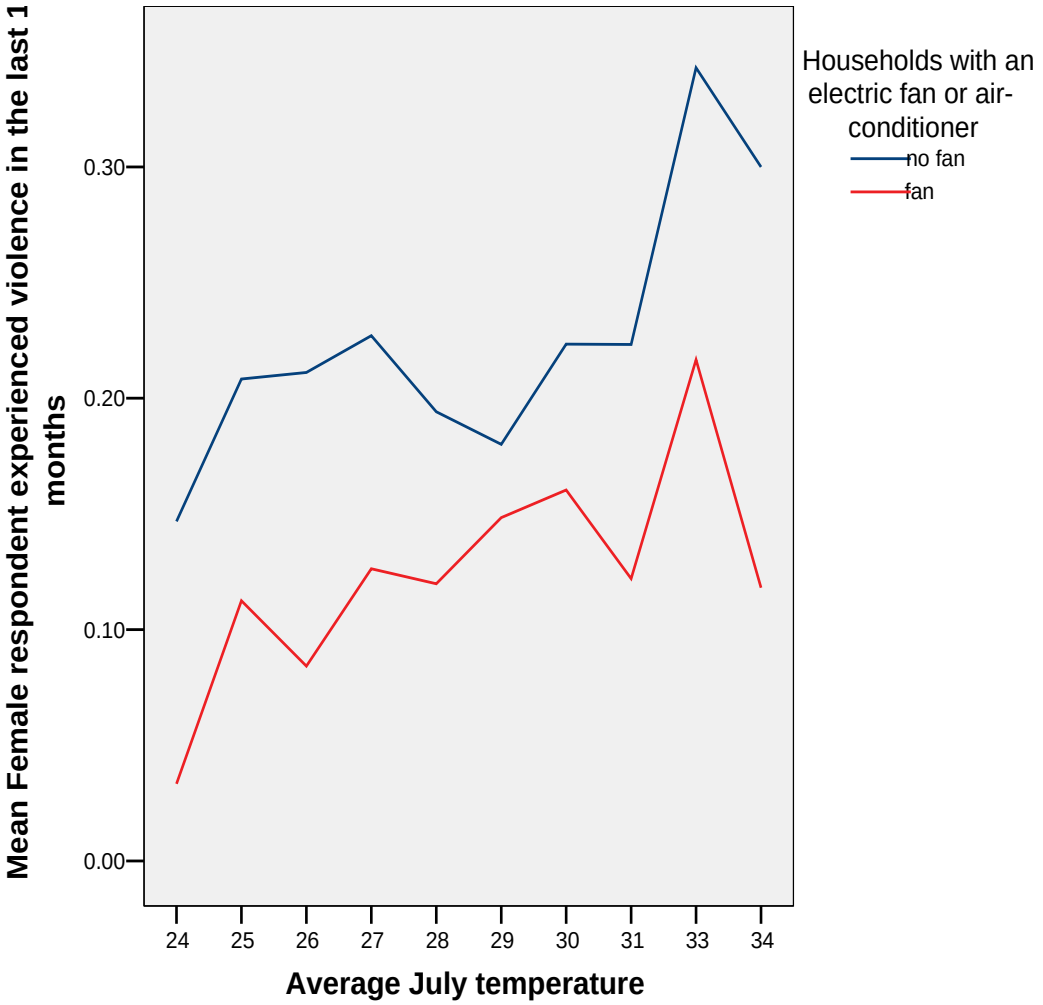
Fieldwork for DHS 1995 was carried out in winter – the hottest estimated temperature in a DHS 1995 interview, using the above formula, is 27°C. Future researchers could consider the month and time-of-day in which interviews were carried out, if they wish to compare DHS 1995 with DHS 2005; the increasing ownership of fans and air-conditioning in Egypt since 1995 is another relevant factor.

I round each temperature to the nearest whole number. This paper does not assess the influence of other factors such as humidity or wind speed, but future researchers could control for them. As a proxy for annual temperature at each governorate, I use the average of maximum and minimum temperatures in July (generally the hottest month).

RESULTS

I begin with a Chart to assess if hotter parts of Egypt have more violence than cooler pats of Egypt, as previous research in other countries suggests. The average of minimum and maximum temperatures in July were calculated (as explained in the previous section), as an estimate of how hot each governorate is.

CHART 1: Relationship between domestic violence and temperature



Source: DHS 1995 (6,536 households).

Chart 1 suggests a strong link between temperature and violence against women: both lines on Chart 1 rise from left to right, indicating more violence at high temperatures. All governorates with a July temperatures over 30°C are in Upper Egypt; these locations (on the right of Chart 1), generally have more domestic violence – up to about 30%, in households with no fan and at locations where the July temperature is about 34°C. Note that although all of the hottest governorates are in Upper Egypt, not all of Upper Egypt is very hot – even in summer. This finding is consistent with much of the literature reviewed in the introduction: high temperatures are associated with more violence. Such (epidemiological) evidence cannot be entirely convincing – an association (between high temperature and more violence) does not prove causation: other factors could affect results. Some writers (e.g. Van de Vliert et al, 1999) emphasise cultural explanations for violence; perhaps Upper Egypt has a different culture to the rest of Egypt, but cultural differences do not explain why fan ownership seems to reduce violence. There is a dip in violence prevalence at the right of Chart 1, as temperatures rise from 33 to 34°C: this seems to support the 'curvilinear hypothesis' discussed by Van de Vliert et al (1999), but there are too few cases to trust (the DHS 2005 only includes 127 households in locations with July temperatures of 34°C).

Chart 1 seems reminiscent of graphs which analyse links between temperature and other forms of violence, such as Figure 5 of Simister & Van de Vliert (2005: p. 61), of murders in Pakistan; and Figure 8 of Simister & Cooper (2003), which shows assaults in Los Angeles, USA. All three Charts show an upward trend as we go from left (cool) to right (hot). Chart 1 in this paper may be the first Chart (in any country) to show this apparent temperature effect for Gender-Based Violence.

Another feature of Chart 1 is that households which own one or more electric fans tend to have less violence. A fan reduces the 'effective temperature' (because humans are better able to keep cool in moving air), so a fan may help people cope with high temperatures. To investigate the effects of fans and air-conditioning on domestic violence, Table 1 reports prevalence of domestic violence in all three surveys. Households owning both fan and air-conditioner are included in 'air-conditioner'. In Table 1, WAS data is not consistent with DHS data: DHS referred to violence in the 12 months before the interview, whereas the WAS questionnaire asked about violence in the previous 6 months.

Table 1: prevalence of domestic violence by fan/air-conditioner ownership

Survey		Men experiencing violence	Women experiencing violence
DHS 1995	no fan		21 % (3,010 cases)
	fan		13 % (3,526 cases)
DHS 2005	no fan	1 % (618 cases)	23 % (618 cases)
	fan	0.4 % (4,423 cases)	16 % (4,424 cases)
	air-conditioner	0 % (200 cases)	5 % (200 cases)
WAS	no fan	4 % (439 cases)	20 % (442 cases)
	fan	1 % (1,979 cases)	13 % (1,989 cases)
	air-conditioner	1 % (69 cases)	3 % (69 cases)

Table 1 indicates that men generally experienced much less domestic violence than women. For example, in DHS 2005 households with a fan but no air-conditioner, 0.4% of men and 16% of women experienced domestic violence from their spouse, in the 12 months preceding the interview. In Egypt (at least), most domestic violence between spouses is women being hit by men. The remainder of this paper focuses on violence against women, and hence uses the term 'Gender-Based Violence' (GBV) rather than the more general term 'domestic violence'.

Table 1 indicates less GBV in homes with fans or air-conditioning, than in homes without fans; air-conditioning appears far more successful than electric fans, in reducing GBV. In DHS 2005, for example, the fraction of women experiencing GBV varies from 23% if no fan, or 16% if a fan is owned, or 5% if her home has air-conditioning. DHS 1995 did not ask about air-conditioner ownership, or about violence against men. In Table 1, about half of the DHS 1995 households owned an electric fan (3,526 homes owned a fan; 3,010 did not). Ten years later, the vast majority of homes owned an electric fan (in both DHS 2005 and WAS).

This paper now turns from prevalence of GBV, to attitudes about GBV. WAS respondents were asked for their agreement or disagreement towards various justifications for male violence against women, using several questions (see Data and Methods section).

Table 2: Attitudes to Gender-Based Violence, by fan/air-conditioner ownership

survey	fan or air-conditioner ownership	agreement that domestic violence is justified, if a wife refuses sex with her husband	
		Male respondents	**Female respondents**
DHS 1995	no fan		84 % (2,964 cases)
	Fan		72 % (3,429 cases)
DHS 2005	no fan		51 % (2,031 cases)
	Fan		35 % (15,099 cases)
	air-conditioner		26 % (677 cases)
WAS	no fan	27 % (309 cases)	27 % (433 cases)
	Fan	19 % (2,016 cases)	16 % (1,962 cases)
	air-conditioner	10 % (93 cases)	1 % (69 cases)

Table 2 is similar to Table 1; Table 2 deals with attitudes to violence, whereas table 1 refers to occurrence of violence. Table 2 indicates an apparent link between fan ownership, and acceptance of GBV. It appears that, among both men and women, there is less acceptance of GBV if there is an electric fan or air-conditioner in the home. Evidence in Table 2 is consistent with the idea that if the respondent feels too hot, s/he is more likely to consider violence acceptable.

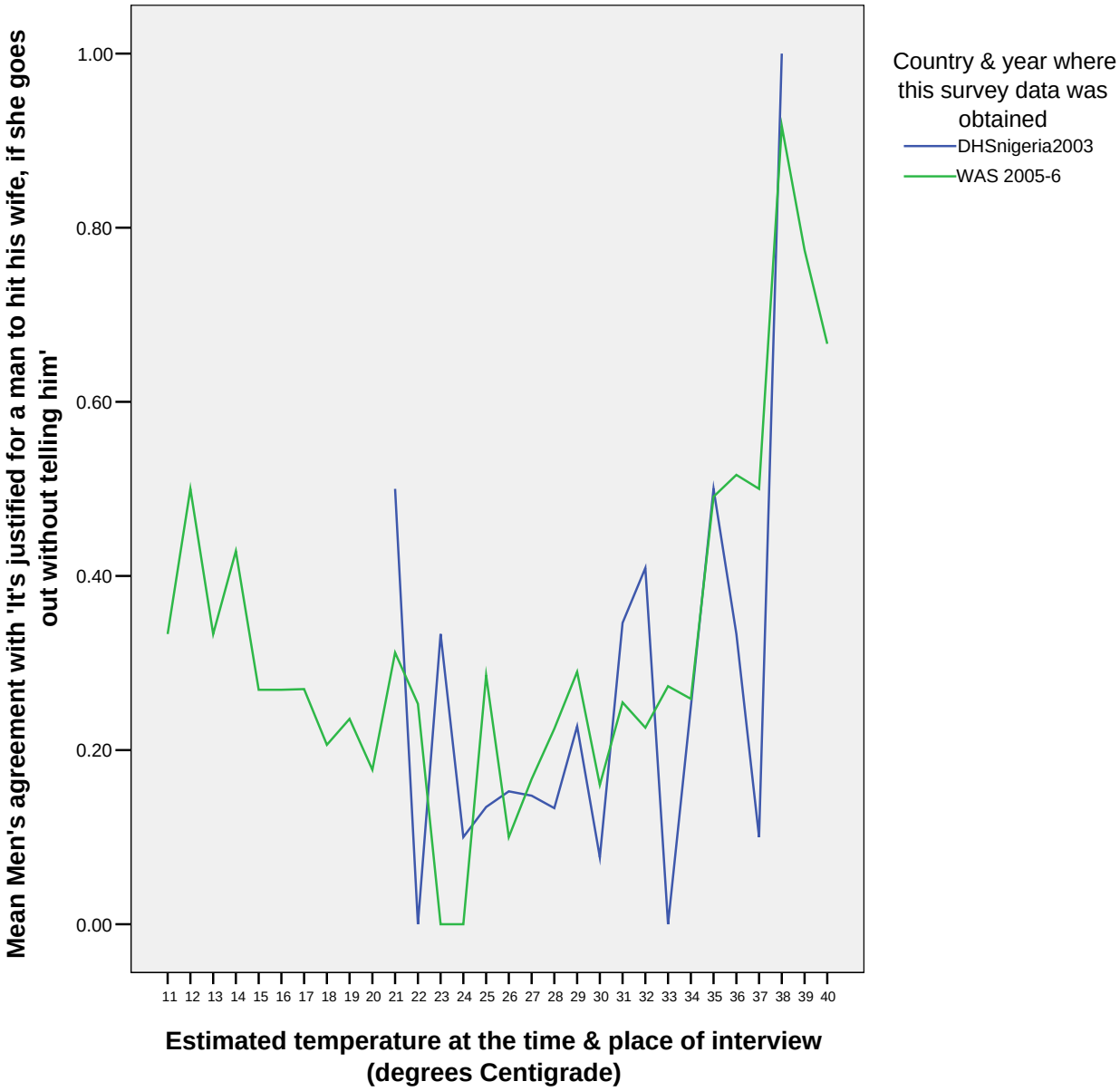
Another lesson suggested by Table 2 is a trend for reduced acceptance of GBV in Egypt. There is less acceptance among WAS respondents than in DHS 2005 (for example, 27% in WAS compared with 51% in DHS 2005, for households with neither fan or air-conditioning). The difference between DHS 1995 and DHS 2005 is even larger – among homes which owned neither fan or air-conditioner, acceptance fell from 84% in DHS 1995 to 51% in DHS 2005. Possible explanations for this (such as increased education) are beyond the scope of this paper.

Chart 2 presents evidence that hostile temperatures are associated with more acceptance of violence, from answers to six attitude questions – including the question in Table 2 (see Data and Methods section). The horizontal axis of Chart 2 represents estimated temperature at the time of interview; note that this is different to Chart 1, in which the horizontal axis was average July temperature. The right-hand side of Chart 2 shows how respondents react to high temperatures.

Normal human blood temperature is about 37°C. Humans generate heat due to processes such as heartbeat and digestion, which help maintain thermal comfort if the air temperature is below 37°C. One way humans cope with high temperatures is by sweating (Brück, 1989: p. 634); people in hot locations (e.g. Upper Egypt) should be encouraged to drink sufficient water. A woman may be able to avoid being hit by her husband, if she gives him a drink – such knowledge can empower women, and could be taught in Egyptian schools. If sweating fails to keep a human body within safe temperature limits, other mechanisms are essential: prolonged blood temperatures above 39.5 to 40°C "usually soon leads to death" (Brück, 1989: p. 642). At temperatures over 37°C, moving air (from a fan, for example) may increase, rather than reduce, the problem of heat stress.

Adrenaline & noradrenaline are associated with hot temperatures (Kukkonen-Harjula et al, 1989), and are part of human temperature regulation systems (Barrington, 1983: p. 1081; Kellogg, 2006). But adrenaline and noradrenaline have unfortunate side effects, often called the "fight-or-flight" response: noradrenaline may cause anger and aggression (Kemper, 1990: p. 31). There may be other possible explanations for violence in hot weather: for example, El-Migdadi, Nusier & Bashir (2000) report higher levels of testosterone in summer (in both men and women) – testosterone is associated with aggression (Kemper, 1990). It is beyond the scope of this paper to assess which, if any, of these hormones is responsible for the pattern in Chart 1. If humans produce a hormone such as adrenaline, noradrenaline, or testosterone under heat stress, we might expect them to behave aggressively – which could explain the upward trend in violence (from cold to hot temperatures) in Chart 1.

CHART 2: Relationship between male acceptance of violence, and temperature



Source: male respondents only, WAS Egypt (2,446 cases) and DHS Nigeria.

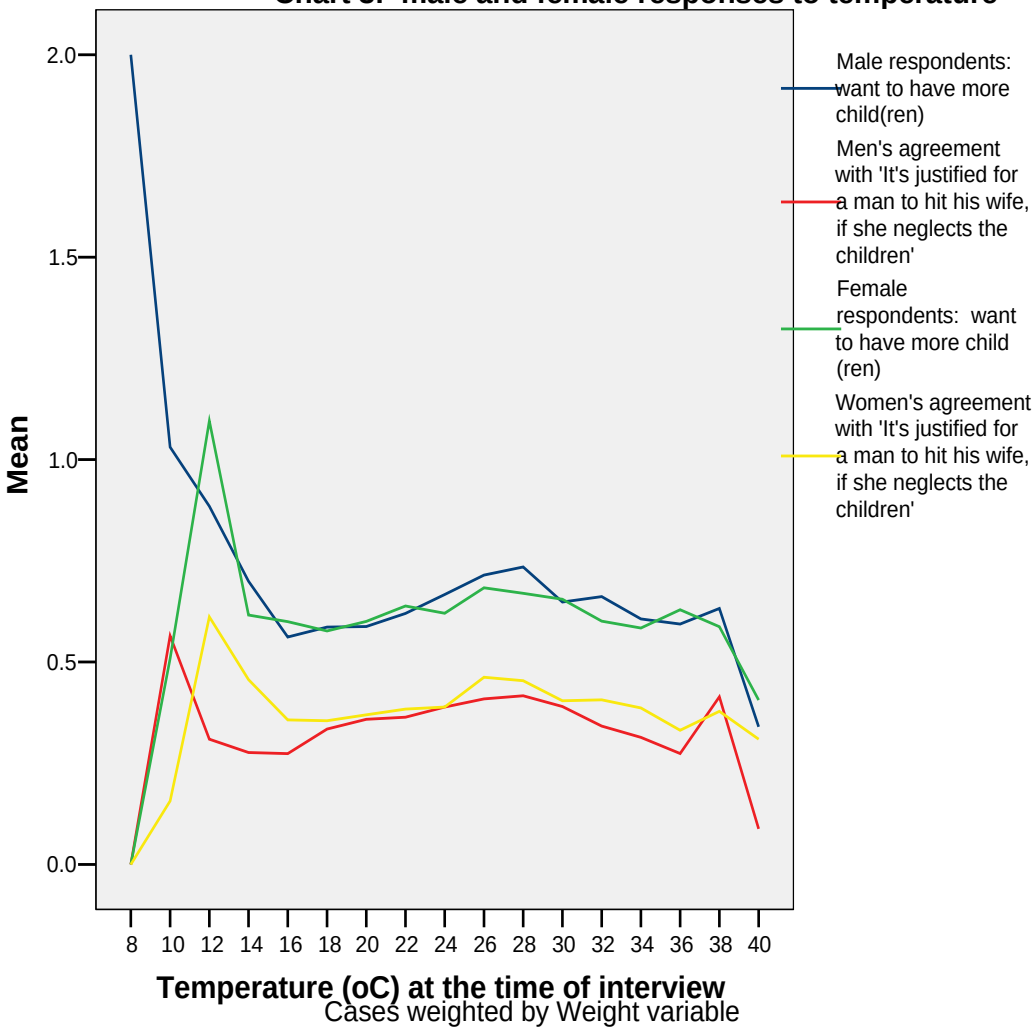
Chart 2 examines possible links between male attitudes to GBV (vertical axis), and temperature at the time of interview (horizontal axis). This chart isn't entirely clear: for future surveys, a larger sample-size would help. There are no Nigerian households where my estimate of the temperature is over 38 degrees.

There is a dramatic change on the right: as temperatures rise over 23°C, we see a steady rise in acceptance of violence in both lines in Chart 2. Previous researchers found (controversial) evidence of relationships between testosterone and/or noradrenaline, aggression, and sexual behaviour such as rape; but it isn't clear if testosterone and/or noradrenaline are associated with aggression, or anger, or seeking dominance over others, or response to challenges to their control (Kemper, 1990: pp. 30-2).

GBV (rather than domestic violence) is an appropriate term for attitude questions in Chart 2, because of the asymmetry of gender relations. For example, it seems inappropriate to ask if a woman could hit her husband if he went outside without telling her, because men don't need to ask their wife's permission. Such gender asymmetry is not confined to Muslim countries (for example, in the traditional Christian marriage ceremony, a woman promises to obey her husband – but a man does not promise to obey his wife).

Chart 2 suggests men are more likely to accept violence if they are very hot; perhaps men are also more violent at such times. Most DHS 2005 interviews were in May; perhaps much of the violence reported occurred in the previous summer, such as in July (usually the hottest month in Egypt), but we cannot tell which month GBV occurred. Future surveys could ask how much GBV occurred in the month before the interview.

Chart 3: male and female responses to temperature

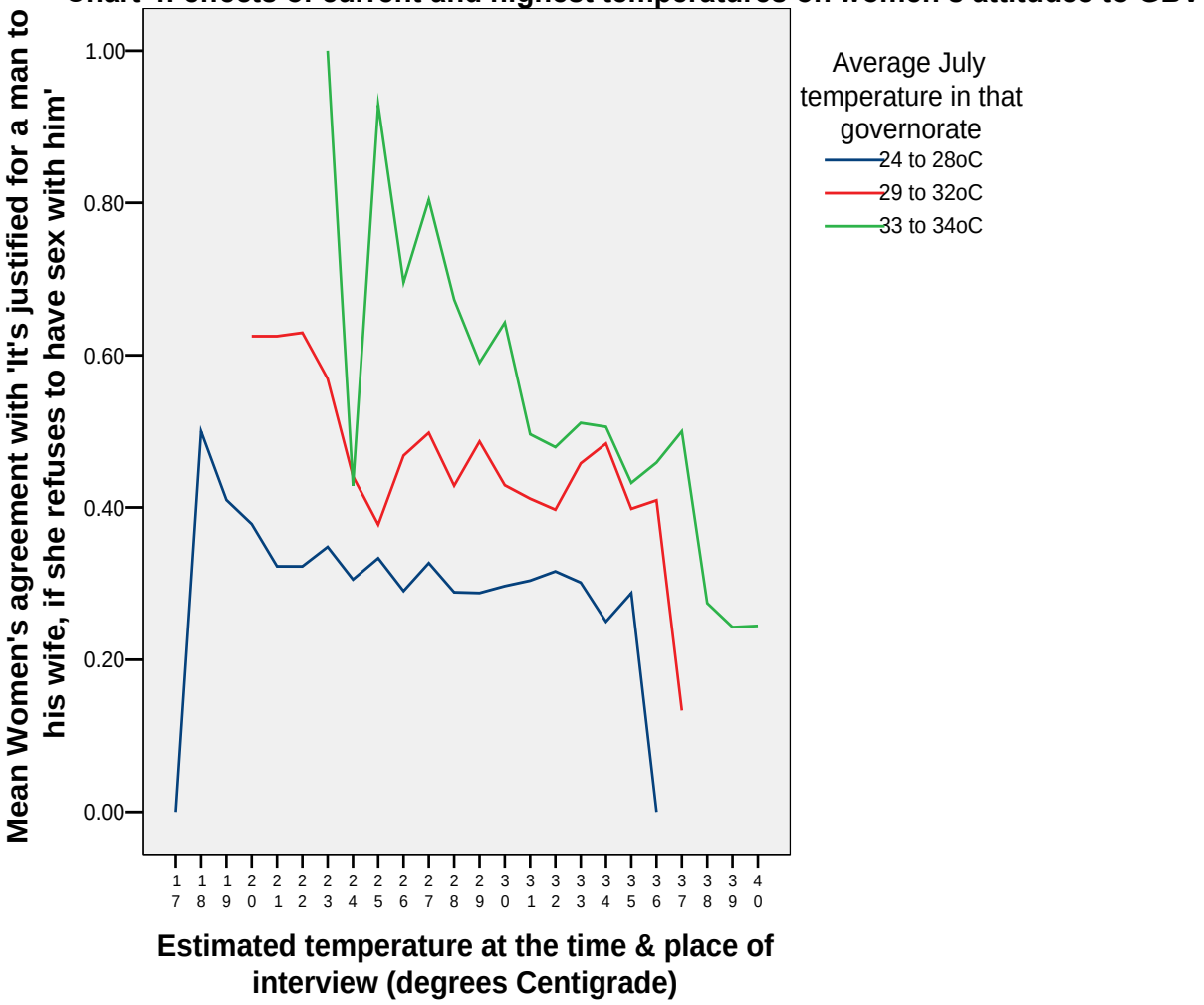


Source: DHS India.

Chart 3, above, refers to India; it uses the 'Demographic & Health Survey' survey, 1998 to 2000. Chart 3 has two characteristics that seem surprising. Firstly, it seems that there is a spike in Chart 3, at about 26-28oC: respondents are more likely to find GBV acceptable at this temperature. In addition, there is a clear similarity between this variable, and wanting more children. According to research summarised in the introduction, adrenaline and/or noradrenaline cause aggression at high temperatures; but this doesn't explain an increase at moderate temperatures; a temperature about 26 or 28 decrees Centigrade might seem pleasant, rather than stressful. A second surprise in Chart 3 is that women seem similar to men. This echoes the pattern in Tables 1 and 2, but it seems hard to explain.

Chart 4 considers women's attitudes to GBV, considering both the current temperature (which may affect her behaviour), and the July temperature in that governorate (which may have made her husband aggressive, causing her to become submissive). Due to the large sample size, DHS 2005 data is used (DHS 1995 is of limited help, because fieldwork was in winter: no estimated current temperatures exceed 27°C). For clarity, the July temperature (on the horizontal axis of Chart 1) is grouped into three temperature bands (24 to 28, 29 to 32, and 33 to 34°C). The horizontal axis of Chart 4 is the same variable as the horizontal axis of Charts 2 & 3: the current temperature (i.e. estimated temperature at the time of interview). Only 2 of the DHS 2005 respondents were interviewed at an estimated temperature of 17°C, so the apparent fall in acceptance of GBV on the extreme left of Chart 4 cannot be relied on.

Chart 4: effects of current and highest temperatures on women's attitudes to GBV



Source: DHS 2005 (10,689 cases at 24-28°C; 4,551 cases at 29-32°C; 2,319 cases at 33-34°C)

Chart 4 shows two effects of temperature. As we go from left to right, women's acceptance of male violence tends to fall – if a woman is hot, she is less likely to think a man justified in hitting his wife (this is the opposite pattern to Chart 3). On the other hand, women in governorates with the hottest summers (July temperature 33 to 34°C, the top line in Chart 4) are more accepting of male violence, than are women in cooler governorates (July temperature 24 to 28°C, the bottom line in Chart 4); this is consistent with Chart 3. Chart 4 suggests that the apparent simplicity of Chart 3 is misleading: women on the right of Chart 3 seem more accepting of GBV, but this may be the indirect effect of hot summers – Chart 3 used current temperature, but we only observe a high current temperature in a governorate which has hot summers, and hence a high risk of male aggression.

There are many influences on attitudes to GBV, apart from temperature, some of which are discussed by Zanaty et al (1996), and Zanaty & Way (2006). A conventional approach to such problems is to use regression; this is explored in the appendix.

Conclusion

It is clear from previous research that there are many influences on Gender-Based Violence, such as education. The introduction to this paper reports evidence that temperature affects the prevalence of various types of violent behaviour, so it is not surprising to find links between domestic violence and temperature. Some apparent effects of temperature variations are explored in this paper, using data from three household surveys in Egypt.

Thanks to DHS sharing a common methodology, it may be possible to combine DHS data from more than one country, for analysis; but this would be risky – we might be misled by legal, cultural, or other differences, so we could not be sure what role temperature plays. There are temperature differences within Egypt: for example, Upper Egypt tends to be hotter than the rest of Egypt. However, variations in annual temperature within Egypt are limited; India may be the best country to study, to investigate geographical variations in violence. But Egypt is one of the best countries to study, to assess effects of heat stress on Gender-Based Violence (and other issues, such as the 'curvilinear hypothesis'), because it has a large population; a unified legal system (unlike countries such as Nigeria, where Sharia law is enforced in some but not all Nigerian states); and a common language, Arabic (reducing the risk of questionnaire translation affecting responses). Most important, Egypt has a large variation in temperatures between summer and winter; we can compare responses to interviews from different months, to assess effects of temperature on attitudes.

This paper reports that male acceptance of violence tends to rise if temperature increases, over about 34°C. But only a small fraction of the WAS sample is above 34°C, and neither DHS survey (1995 and 2005) interviewed men. In my view, DHS is the best source of data on domestic violence, and on attitudes to domestic violence; but DHS could be even better:

- DHS interviewers could record air temperature, at the time & place of interviews (a 'data logger' would be ideal: this could also measure factors such as humidity and wind speed). However, such data collection would raise the cost of survey.
- DHS staff could consider seasonality when choosing a sample. It's not feasible for all respondents to be interviewed on the same day & time of day; a quota system may be appropriate, to control the fraction of the sample interviewed at each temperature.
- DHS could ask about violence in the month (not just year) before interview.
- DHS could include a sample of men. To understand GBV, it may be more important to interview men than women, because men are usually the cause of violence.

If ORC Macro can solve some or all of the above issues, a future DHS survey in Egypt may become one of the most useful datasets ever collected for studying GBV. There is a lot at stake: Gender-Based Violence is a problem in many, if not all, countries.

Research in this paper indicates the importance of heat stress, as a cause of violence. Women are not simply passive victims in this respect: women appear (from Chart 3) to react similarly to men to thermal stress, and some women use physical violence against their husband (Table 1). But most domestic violence in Egypt is men attacking women; high temperatures in summer, especially in Upper Egypt, appear to be a major cause of male violence against women. The increasing ownership of fans and air-conditioning in Egypt (shown in Table 1) may reduce GBV. However, not all households in Egypt can afford air-conditioning; and women's control over household spending (to buy a fan or air-conditioning) is limited. For many women, offering their husband a drink of water (at the hottest time of day) may be the best way to reduce or avoid domestic violence. Governments and non-governmental organisations could empower women, by educating them about the effects of temperature stress.

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