Gender Discrimination, Gender Disparities in Obesity and Human Development

Ferretti, Fabrizio and Mariani, Michele

Unniversity of Modena and Reggio Emilia

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Fabrizio Ferretti*, Michele Mariani

Department of Communication and Economics, University of Modena and Reggio Emilia, Reggio Emilia, Italy.

Corresponding author at: School of Social Sciences, Department of Communication and Economics, University of Modena and Reggio Emilia. Dossetti Building, Viale Allegri 9 – 42121, Reggio Emilia, Italy.
fabrizio.ferretti@unimore.it

Abstract

Measuring gender inequality and women's empowerment is essential to understand the determinants of gender gaps, evaluate policies and monitor countries' progress. With this aim, over the past two decades, research has mainly been directed towards the development of composite indices. The purpose of this paper is to introduce a new and interdisciplinary perspective to the current debate on measuring gender inequality in human development. As a starting point, we develop a simple macroeconomic model of the interdependence between human development and gender inequality. We then introduce a biometric indicator, based on the ratio of female to male body mass index, to measure women's empowerment at the country level. Finally, by using the latest available data, we examine the ability of this biometric indicator to capture countries' performance in achieving gender equality. We obtain five main results: 1) we provide a theoretical framework to explain the joint determination of human development and gender inequality; 2) we show how to use this framework to simulate the impact of exogenous shocks or policy changes; 3) we demonstrate that exogenous changes have a direct and a multiplier effect on human development and gender inequality; 4) we find that the distribution of obesity between the female and male populations represents a useful proxy variable for measuring gender equality at the country level; 5) finally, we use these results to integrate and develop existing knowledge on the 'ecological' approach to the overweight and obesity pandemic.

Introduction

Equality between men and women, in terms of both opportunities and outcomes, is a fundamental dimension of human development (UNDP, 1995). Since the *Beijing Declaration* in 1995 (United Nations, 1996), significant progress has been made worldwide towards more gender-equal societies (World Bank, 2011). However, forms of gender discrimination still remain unquestionable realities in most parts of the world, particularly in developing countries (United Nations, 2014). The development of 'gender-equity-sensitive' indicators, albeit difficult, is an essential task to gain a better understanding of the determinants of gender gaps, evaluate policies and monitor countries' progress (Beneria & Permanyer, 2010). With this aim and to capture a complex multi-dimensional phenomenon, research has mainly focused on the use of composite indices (Anand & Sen, 1995). As a result of broad collective efforts, several composite measures of gender disparities are now available to researchers and policymakers (van Staveren, 2013).

The purpose of this paper is to introduce a new perspective to the current debate on the measurement of gender inequality in human development (Human Development Report Office, 2015). So far, there has been little discussion of the possible use of biometric indicators to measure gender disparities at the country level. However, research has shown that the patterning of obesity prevalence across countries is gendered (Kanter & Caballero, 2012) and also that international differences in obesity prevalence between men and women are significantly associated with several countries' measures of gender inequality (Garawi et al., 2014).

This study takes an interdisciplinary approach to explore the relationship between gender inequality and gender disparities in overweight and obesity. As a starting point, we sketch a simple macroeconomic model to analyse the two-way interplay between human development and gender inequality. We then introduce a basic indicator – based on the ratio of female to male body mass index – to measure gender inequality at the country level. Finally, by using the latest available data, we examine the ability of this biometric indicator to predict countries' performance in achieving gender equality, as compared to the six most common indices of gender discrimination currently available to the international research community.

We obtain five main results. First, we provide an economic framework to explain the joint determination of human development and gender inequality. Second, we show how this framework can be used to simulate the impact of exogenous shocks (due, for instance, to policy changes). Third, we demonstrate that exogenous shocks (such as an action to promote women's empowerment) have both a direct as well as an indirect (i.e. 'multiplier') effect on human development and gender inequality. Fourth, we find that the distribution of obesity between the female and male populations represents a useful proxy variable for measuring gender equality at the country level. Fifth, and finally, we use these results to develop existing knowledge on the 'ecological' approach to the current overweight and obesity pandemic (Egger & Swinburn, 1997).

Theory

Multiplier Effects in the Interplay Between Human Development and Gender Inequality

A useful way of addressing the relationship between gender discrimination and human development is to look at gender equality both as an input and as an outcome of society's reproduction process. From this viewpoint, eliminating barriers that limit women's capabilities, opportunities and empowerment has been shown to generate a positive feedback loop between women's conditions, economic growth and human development (Cuberes & Teignier, 2014; Kaaber & Natali, 2013). Specifically, promoting gender equality tends to improve women's health and education. These improvements in women's stock of human capital positively affect the political and economic empowerment of the female population (Galor & Weil, 1996; Lagerlöf, 2003). As a result, countries are able to make more efficient use of their human resources. Finally, a full and better use of human resources fosters economic growth (Esteve-Volart, 2004; Hsieh et al., 2013); in turn, the growth process may support a virtuous circle in which increasing income per capita stimulates further progress in human development and gender equality (Becker, 1991; Doepke & Tertilt, 2009; Greenwood, Seshadri & Yorukoglu, 2005).

Figure 1 illustrates a simplified macroeconomic model of human development and gender inequality as being determined simultaneously. The horizontal axis indicates the level of human

development and the vertical axis indicates the level of gender inequality. Specifically, we measure human development and gender inequality using the UNDP's Human Development Index (*HDI*) and Gender Inequality Index (*GII*), respectively (UNDP, 2014). To simplify, let us consider linear relationships. On the one hand (i.e. from the gender inequality perspective), the effect of higher human development in improving gender equality is represented by the function *GII*(*HDI*), depicted in blue. This function is downward sloping, showing that improvements in a population's health, education and economic conditions (i.e. a rightward movement along the x-axis) normally translate, at least partially, into lower discrimination against women. On the other hand (i.e. from the human development perspective), the effect of better gender equality in promoting human development is represented by the function *HDI*(*GII*), depicted in red. This function – plotted in the space (*HDI*, *GII*) for ease of exposition – is also downward sloping because greater gender discrimination (i.e. an upward movement on the y-axis) means an increasingly inefficient use of human resources that hinders economic growth and negatively affects the level of human development. Finally, the different slope of the two functions reflects the fact that – all other things being equal – a one-unit increase in human development has an effect on gender inequality which is not generally of the same magnitude as the effect on human development of a one-unit increase in gender inequality (Kaaber & Natali, 2013).

In this model, human development and gender discrimination are both endogenous variables and their equilibrium levels (*HDI** and *GII**) are determined by the intersection of the two curves (point *E* in Figure 1) as a result of the interplay between the *GII*(*HDI*) and *HDI*(*GII*) functions. This process can be described as follows. Given the impact of human development on gender inequality – i.e. given the blue *GII*(*HDI*) curve – a level of human development below the equilibrium (for instance $HDI_1 < HDI^*$) determines a level of gender inequality above the equilibrium value (here equal to GII_1, point *A*). However, given the impact of gender inequality on human development – i.e. given the red *HDI*(*GII*) curve – GII_1 implies a level of human development equal to HDI_2 (point *B*) that is greater than HDI_1, but still less than *HDI**. In turn, HDI_2 allows society to reduce gender inequality until GII_2 (point *C*) by moving downward along the blue *GII*(*HDI*) curve. Again, this leads to a further increase in human development (point *D* on the *HDI*(*GII*) red curve) and so forth. This process continues, reducing gender inequality and increasing human development, until both variables converge to their long-run equilibrium values (precisely *HDI** and *GII**) and vice-versa for any level of human development above *HDI**.

Movements along given functions, as shown in Figure 1, illustrate the recursive nature of the relationship between human development and gender inequality. Conversely, exogenous changes in the level of human development, or in that of gender inequality, result in a shift in either or both functions (i.e. these are shocks that shift the entire function). In order to analyse the impact of an exogenous shock, we may rewrite our two basic functions as *GII*(*HDI*, *α*) and *HDI*(*GII*, *β*), in which *α* and *β* are catchall variables that act as 'shifters' of the respective curves. More specifically, *α* stands for all factors, other than human development, that may affect gender inequality (such as policy or cultural changes), whereas *β* stands for all factors, other than gender inequality, that may affect human development (such as economic or institutional changes).

Let us consider, for example, a country where a new and progressive government puts through a women-friendly reform programme that eliminates legal barriers to women's inclusion. An exogenous improvement in gender equality, as shown in Figure 2, shifts downward – from the original dark blue *GII*(*HDI*, $α_0$) curve to the new light blue curve *GII*(*HDI*, $α_1$) – the relationship that shows the effect of human development on gender inequality. In other words, after the policy shock, there is less gender discrimination for any given level of human development. If there were

no effects of women's conditions on human development, the decrease in gender inequality would simply match the direct effect of the reform programme on *GII* (this is shown as the movement from point *F* to point *H* and thus from GII^*_0 to GII' in Figure 2). However, the model also shows a 'multiplier effect'. The decrease in discrimination against women – via the human capital channel – promotes economic growth and human development. These improved general economic and social conditions feed back to generate an indirect additional decrease in gender discrimination (this is shown as the movement from *H* to *E*, i.e. from GII' to GII^*_1). As a result, the long-run equilibrium level of gender inequality and human development ends up in *E* (HDI^*_1, GII^*_1).

We can similarly use our model to figure out the effects of a negative exogenous shock on gender inequality – i.e. a shock that shifts the *GII*(*HDI*, α) function upward – due, for example, to the rise of a radical interpretation of religious doctrines (as suggested by the recent experience of several North African and Middle East countries, resulting from the failure of the so-called 'Arab Springs'), or even to a government's severe cuts in social programmes against gender discrimination as a response to tightening public budget constraints (as in the case of some southern European countries in the aftermath of the 'Great Recession' of 2008–09). These negative shocks increase gender inequality for any given level of human development and give rise to a negative feedback loop: i.e. greater inequality undermines human development, providing the conditions for even greater gender inequality, and so on.

This model is also able to explain the direct and indirect effects on gender inequality of an exogenous change in human development due, for instance, to a change in the economic environment (such as the development of new technologies that allow labour, and other factors of production, to be used more effectively boosting economic growth). In this case, as shown in Figure 3, the *HDI*(*GII*, β) curve shifts rightward, indicating a higher level of human development for any given value of gender inequality. This kind of shock generates positive feedback effects that move the long-run equilibrium levels of gender inequality and human development from the initial point *F* to the final point *E*, as the sum of a direct effect (from *F* to *H*) and an indirect (i.e. a multiplier) effect (from *H* to *E*). It is worth noting that in both cases (Figures 2 and 3), when one of the two functions shifts, the magnitudes of the resulting equilibrium *HDI* and *GII* change depending on two factors, namely the size of the shift and the steepness of the function that does not change. Specifically, the former determines the size of the direct effect, whereas the latter determines the size of the multiplier effect.

To provide a better understanding of the difference between these two (direct and indirect) effects, let us consider again the impact of a programme to reduce gender disparity. Figure 4 reproduces the comparative statics analysis from Figure 2. Now the government may introduce a 'minor' reform (e.g. in December 2003 Norway passed a law that requires large companies to have at least 40% of company board members to be women (Smith, 2014)), or a major reform (e.g. in December 2015 women in Saudi Arabia took part in the country's elections, as both voters and candidates for the first time ever (BBC, 2015)). In both cases, on the one hand, the extent of the reform determines the size of the downward shift of the *GII*(*HDI*, α) curve and on the other hand, for any given shift of the *GII*(*HDI*, α) curve – for instance from *GII*(*HDI*, $α_0$) to *GII*(*HDI*, $α_1$) – the slope of the *HDI*(*GII*, β) curve determines whether the policy change leads to a relatively small or large multiplier effect. Specifically, if the *HDI*(*GII*, β) function that shows the impact of gender inequality on human development is relatively flat (such as the dashed red curve in Figure 4), the equilibrium changes from initial point *F* to final point *E''*, and the positive multiplier effect of the reform on both gender inequality and human development will be relatively large (from GII' to GII^*_2 and from HDI^* to HDI^*_2, respectively). Conversely, if the *HDI*(*GII*, β) function is relatively steep (such in the case of

the solid red curve), the same reform will exert a small effect on the final *HDI* and *GII* equilibrium values and, under this conditions, society moves from initial point *F* to the final point *E'*.

The slope of the *HDI(GII, β)* curve measures the reactivity of human development to changes in gender inequality. This reactivity is affected by many interrelated cultural, economic and social factors. Therefore, the impact of a given policy in reducing gender discrimination and improving human development (for instance, the introduction of gender quotas on boards of directors) may vary significantly depending on the country's specific characteristics (such as the existence of family-friendly employment regulations, a well-functioning labour market, a meritocratic recruitment system and so forth). Finally, the same analysis holds for a rightward shift in the *HDI(GII, β)* function, where a flatter (steeper) *GII(HDI, α)* curve results in smaller (larger) changes in the final equilibrium level of gender inequality and human development.

Calculation

Human Development and Gender Disparities in Obesity

Unequal health outcomes between men and women reflect the interplay between biological sex and societal gender differences (Annandale & Hunt, 2000). Overweight and obesity are typical, complex, multifactorial diseases in which the inborn genetic characteristics of individuals interact with a wide range of cultural, social and economic variables (Akabas, Lederman & Moore, 2011; Hu, 2008). In particular, the abnormal or excessive fat accumulation, as shown in Figure 5, results from a positive energy imbalance between calorie intake and calorie expenditure. Both mediators of this stock-flow relationship are moderated by physiological adjustments. According to the 'ecological' approach to the problems of overweight and obesity (Kickbush, 1989), however, calorie intake and expenditure are also subject to biological, behavioural and environmental influences (Egger & Swinburn, 1997), (Figure 5 is adapted and modified from Egger & Swinburn's Figure 1.). These environmental influences, in turn, are the result of the interference of a wide range of economic, institutional and socio-cultural factors that operate at both the micro- and the macroeconomic levels (e.g. at individual, family and local community level, and at population or country level).

The ecological paradigm takes the macroeconomic environment as given. One of the main purposes of this study is to integrate this approach by explicitly introducing the determination of human development and gender inequality, and their impact on the diffusion of overweight and obesity between the male and female populations. To this aim, we define and compute the 'gender overweight and obesity ratio' (*GOOR*) as the ratio between the prevalence of overweight and obesity in female (*OOF*) and male (*OOM*) populations (i.e. *GOOR = OOF/OOM*). The essential *Food and Nutrition in Numbers 2014*, recently published by the Food and Agriculture Organization of the United Nations (FAO, 2014) provides comprehensive country profile indicators, including World Health Organization (WHO, 2014) estimates of overweight and obesity prevalence – measured by the % of adults (ages 20+) who have a *BMI* (Body Mass Index, kg/m^2) greater than 25 (overweight) or greater than 30 (obese) – for 158 countries worldwide in 2014.

A simple way to capture the 'gender dimension' of these nutrition-related health outcomes is to examine the impact of human development on the prevalence of overweight and obesity in male and female populations around the world. In Figure 6, in which *OOM* and *OOF* are measured on

the horizontal and vertical axes respectively, each dot indicates a country, classified by the level of human development – i.e. very high, high, medium and low – according to their *HDI* (UNDP, 2014). If the *GOOR* index were around 1 – that is, if the process of social and economic development did not have any appreciable influence on nutrition-related health outcomes – all points should line up close to the grey 45-degree line. But as a matter of fact, the data points lie above the line (*GOOR* > 1) for the vast majority of low-, medium- and high-*HDI* countries and below the line (*GOOR* < 1) for almost all very high-*HDI* countries (a paired samples t-test confirms this intuition: differences between the mean values of *OOM* and *OOF* in each *HDI* group are highly significant, as shown in Table D, S1 File (.XLS) in the Supplementary Content section).

The impact of human development on *BMI* can be further illustrated by focusing on obesity alone (again, measured by the % of adults (ages 20+) who have a *BMI* (kg/m^2) greater than 30). Using the same FAO (2014) and WHO (2014) datasets, we thus compute the 'gender obesity ratio' (*GOR*), as the ratio between the prevalence of obesity in female (*OF*) and male (*OM*) populations: i.e. *OF/OM* = *GOR*. Figure 7 plots the *GOR* on the vertical axis against the *HDI* on the horizontal axis. The scatter plot highlights that there is a strong negative relationship between *HDI* and *GOR*, and also that countries are clearly clustered by their level of development (with an intra-group variability that decline sharply as human development increases). These findings confirm a 'stylized fact': as countries move towards higher levels of economic and social development the prevalence of obesity tends to shift from the female to the male population (Kanter & Caballero, 2012).

Gender Disparities in Obesity and Gender Inequality

In attempting to 'engender human development', the international research community has developed various country-level measures of women's conditions. Over the past two decades, in particular, several leading institutions and organizations have proposed their own indices for measuring gender equality and women's empowerment. Now, six countries' measures of gender discrimination are available for international comparison, i.e. the Gender Inequality Index (*GII*), the new Gender Development Index (*GDI*), the Global Gender Gap Index (*GGGI*), the Gender Equity Index (*GEI*), the Social Institutions and Gender Index (*SIGI*) and the Women's Economic Opportunities Index (*WEOI*). All these statistics are composite indices that measure gender equality (or inequality) on a scale between 0 and 1 (except for the *GDI*) and in the latest available versions they cover a number of countries worldwide that range from 102 to 143, over the period 2012– 14 (a full list of the variables used in this paper and their acronyms is included in Table A, S1 File (.XLS) in the Supplementary Content section).

More particularly, the *GII* is calculated for the Human Development Reports (HDRs) (UNDP, 2014; Gaye et al., 2010) within the United Nations Development Programme (UNDP); it focuses on women's empowerment and measures gender inequality by using five indicators on three key dimensions (reproductive health, political and educational empowerment and labour market participation). The HDRs also provide the new *GDI*, by computing the ratio of female to male Human Development Index (UNDP, 2014). The *GGGI* and *GEI* are instead published by the World Economic Forum (WEF, 2014) and the Social Watch research group (Social Watch, 2012), respectively. They both aim to capture gender disparities. However, the *GGGI* uses 14 indicators for four (economic, education, health and political) dimensions, whereas the *GEI* is composed of 7 indicators on three dimensions (education, economic participation and women's empowerment). The *SIGI* is calculated by the Organisation for Economic Co-operation and Development (OECD), mainly for developing countries, and focuses on social norms that constrain women's lives and on

women's discrimination in social institutions (OECD, 2014). Finally, the *WEOI* of the Economist Intelligence Unit (EIU, 2012) is specifically designed to determine whether a country's legal, social and political environment is more or less favourable to women's economic empowerment (a full description of each index can be found in the issue paper prepared by the HDR for the 2015 meeting on the measurement of gender equality in human development (HDR Office, 2015) and in the van Staveren's (2013) recent comparative analysis of gender indices).

We compute the Spearman's rank-order correlation coefficients to test the strength of the association between these six composite indices and our two biometric measures of gender inequality (that is, *GOOR* and *GOR*). The results are collected in Table 1. It is apparent that there is a strong correlation between the biometric and the composite measures of gender inequality. All the Spearman's coefficients are highly significant ($p < 0.01$). They range from 0.30 to 0.83 for the gender overweight and obesity ratio and from 0.40 to 0.89 for the gender obesity ratio. The association is particularly strong between *GOR* and *WEOI* ($\rho = -0.83$) and especially between *GOR* and *GII* ($\rho = 0.89$) (the latter is a positive correlation because higher *GII* values mean a more unequal society, and vice-versa for the former).

Focusing in particular on the association between the UNDP's Gender Inequality Index (*GII*) and the gender obesity ratio (*GOR*) – given that *GII* is the most widely used 'general index' of gender inequality and that it covers a large number of both developed and developing countries worldwide – Figure 8 plots the level of gender inequality (*GII*) against the level of gender disparities in obesity (*GOR*), with countries classified according to their human development group. There is a clear positive relationship between *GII* and *GOR*, especially in very high, high and medium *HDI* countries. It can be seen from these data that discrimination against women in the social dimension tends to translate into the biometric dimension: i.e. females are more likely to be obese with respect to males in societies in which women suffer from forms of discrimination in the economic, education, health and political dimensions.

Results and Discussion

The empirical evidence presented here can be combined with our theoretical framework. In Figure 9, quadrant I reproduces the joint determination of human development and gender inequality (i.e. Figure 1), whereas quadrants II and III reproduce – in a stylized form – the relationship between gender disparities in obesity and human development (*GOR*(*HDI*), i.e. Figure 7) and that between gender disparities in obesity and gender inequality (*GOR*(*GII*), i.e. Figure 8), respectively.

The interplay between the *GII*(*HDI*) and *HDI*(*GII*) functions – as previously explained in Figure 1 – determines the long-run levels of human development and gender inequality (point *E* in quadrant I). With each pair of a country's gender inequality and human development equilibrium values (*GII** and *HDI**) is associated a given level of gender disparity in obesity, that is a specific distribution of the obesity prevalence between the female and male populations. This resulting equilibrium level of the gender obesity ratio (*GOR**) can be derived from both the inequality perspective, in quadrant III, along the *GOR*(*GII*) relationship (via the 45-degree dotted line), or equivalently from the development perspective, in quadrant II, along the *GOR*(*HDI*) relationship (points *F* and *G*, respectively).

The causal relationship goes from human development and gender inequality to gender disparities in obesity. For measurement purposes, however, this diagrammatical exposition suggests the possible use of the gender obesity ratio as a 'proxy variable' to predict gender inequality in the broader sense. Table 2 presents the results obtained by regressing each of the six indices of gender inequality against the gender obesity ratio (with a flexible log-quadratic specification that allows different non-linear relationships to be dealt with). Except for the Gender Equity Index (*GEI*), variations in the gender obesity ratio predict from one-third to nearly four-fifths of the variations in gender inequality at large. The *GOR* performs particularly well in predicting the level of gender inequality as measured by three leading indices: *SIGI*, *WEOI* and *GII* (the adjusted R^2 is equal to 0.56, 0.65 and 0.78 respectively, and all coefficients are significantly different from zero, $p < 0.01$).

Finally, in order to test the ability of the gender obesity ratio to replicate the ranking of countries based on a general inequality index, Table 3 compares the rankings of the last 20 countries according to their levels of *GII* and *GOR* (that is, the 20 countries with the smallest *GII* and *GOR* values). It is worth noting that there is a substantial overlap between the two rankings. With only small differences in ranking positions, the first 10 places are occupied by the same 8 countries. Furthermore, within the first 20 positions, only 5 countries (those labelled in red) appear only in one ranking. A more exhaustive comparison between the two rankings is illustrated in Figure A (S1 File (.XLS) in the Supplementary Content section), where the absolute difference between each country's position in the *GII* and *GOR* ranking (D_{RANK} = *GII rank* – *GOR rank*) is plotted against the country's position in the gender obesity ratio (for the full sample of 139 worldwide countries). Despite some outliers (for example, Rwanda and Samoa at -62 and +46 respectively), about 75% of the observations fall in the range of +20 and -20 positions. In other words, ranking countries by the ratio of the obesity prevalence between the female and male populations returns nearly the same results as a country's ranking based on a general composite measure of gender inequality, such as the UNDP's Gender Inequality Index.

These findings corroborate the results of previous research (Kanter & Caballero, 2012; Wells et al., 2012; Garawi et al., 2014) and are consistent with the ecological approach to the problems of overweight and obesity (Swinburn et al., 2011). By stressing the importance of environmental influences (i.e. cultural, economic, institutional and social influences), the ecological approach regards obesity as a 'normal' response to an abnormal micro- and macro-environment (Egger & Swinburn, 1997). We are able to enhance this approach and thus our understanding of the obesity pandemic. Specifically, in this study, the macro-environment is no longer an exogenous variable. The levels of human development and gender inequality result from the balancing of the forces that express the two-way linkages between a country's development stage and the conditions of its female population. Individuals make choices within this context and their health outcome in terms of *BMI* (that is, being normal weight, overweight or obese) is a response to a more or less 'obesogenic environment' (i.e. the brown side of Figure 5). This environment may be biased towards the male or female population according to society's general level of human development and gender inequality. As a result, the gender obesity ratio that we observe at a given time and in a given society, summarizes in a single biometric statistic some of the most important dimensions of gender discrimination, and thus it may provide a 'rule of thumb' for measuring women's empowerment and gender equality.

An important policy implication of our findings concerns the role of gender differences in devising and designing innovative strategies for reducing the worldwide prevalence of overweight and obesity. Especially in low- and medium-development countries – where the burden of obesity is predicted to affect an increasing percentage of the female population (WHO, 2014) – effective

strategies to tackle overweight and obesity should not neglect the gender dimension (and vice versa, as without substantial progress in the economic and social condition of the female population, the effectiveness of any action against obesity will be severely reduced). However, the results of this study, are limited by the use of a simplified macroeconomic model. Linear relationships, in particular, may fail to account for intersectionality within a given society and for cultural differences in the nature and extent of gender inequality between countries. Thus, further research on this topic should be designed around the specific characteristics of homogeneous populations, using a more complex (i.e. non-linear) set of relationships and taking advantage of disaggregated microeconomic datasets.

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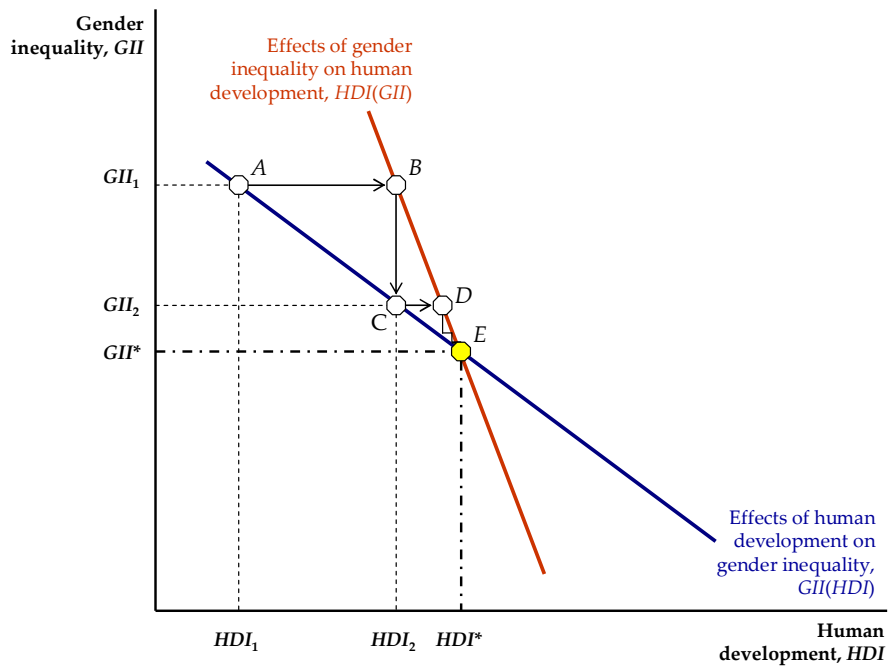
Figure 1. The interaction between human development and gender inequality.
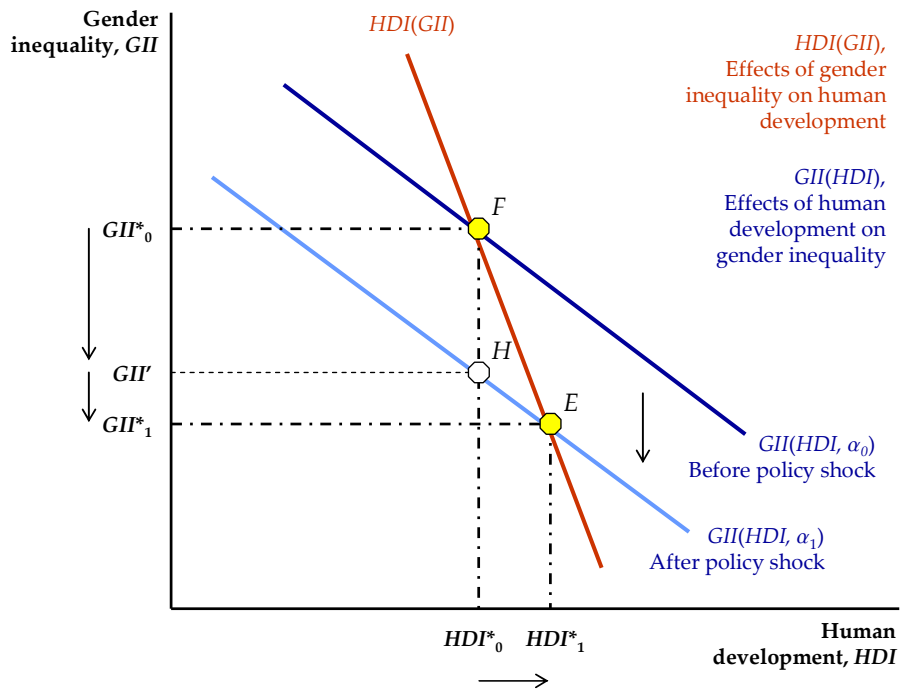

Figure 2. The effects of an exogenous change in gender inequality
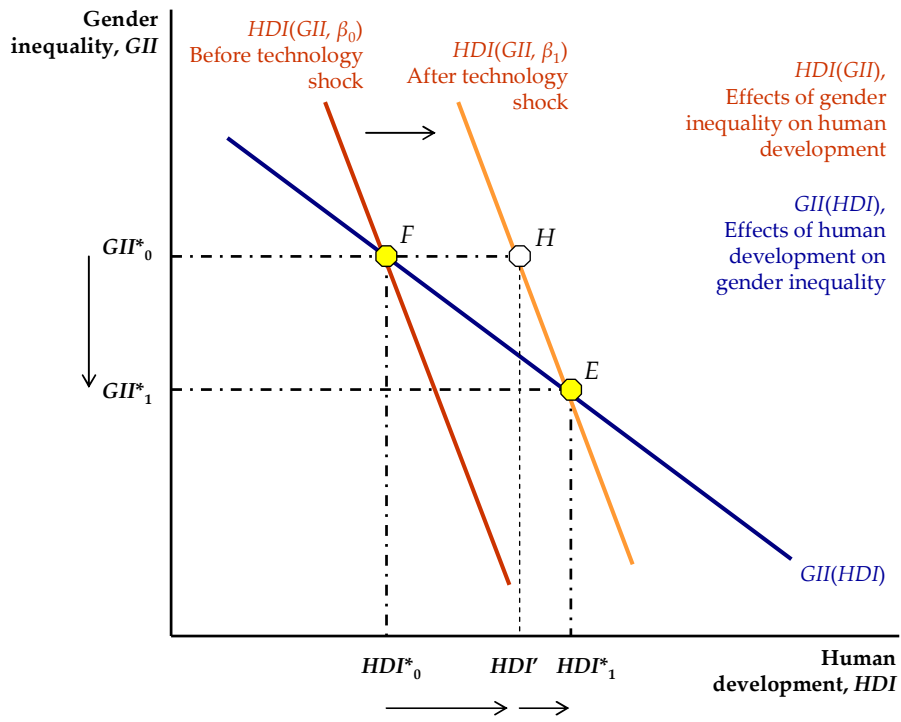
Figure 3. The effects of an exogenous change in human development
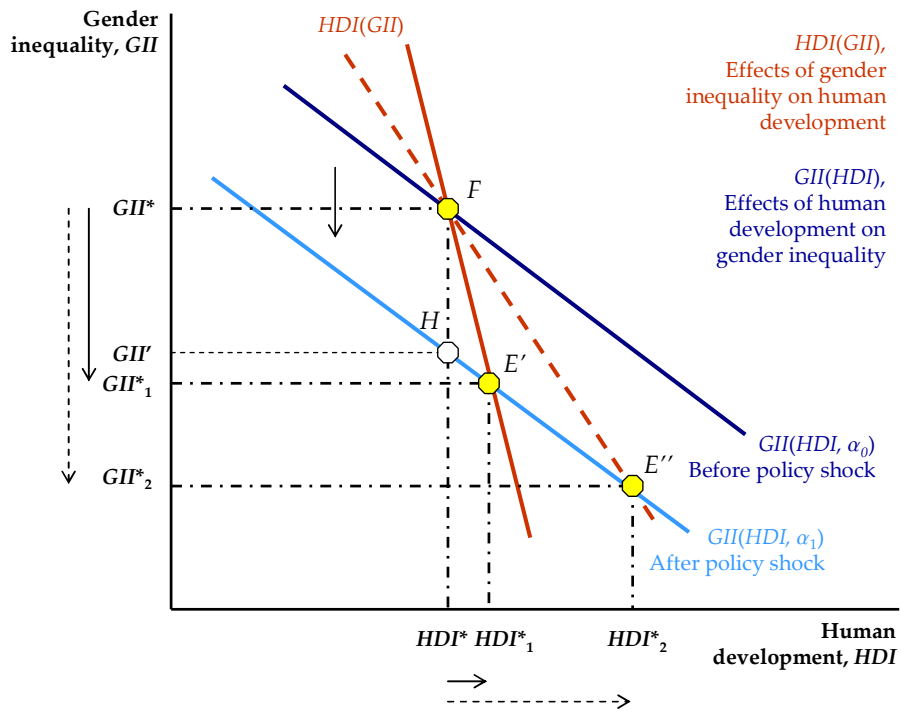
Figure 4. The reactivity of human development to gender inequality

MEDIATORS   **MODERATORS**

Equilibrium fat store = Energy intake − Energy expenditure + Physiological adjustment

INFLUENCES

BIOLOGY → BEHAVIOUR ← ENVIRONMENT

Micro (e.g. family, …)
Macro (e.g. country, …)

FACTORS
Cultural
Economic
Institutional
Social

Equilibrium (*HDI** and *GII**)
HUMAN DEVELOPMENT
GENDER INEQUALITY

---- flow ⎯ stock
Note: adapted and modified from Egger-Swinburn's (1997) Figure 1.

Figure 5. An improved ecological approach to the overweight and obesity pandemic

Figure 6. The gender overweight and obesity ratio (*GOOR*)

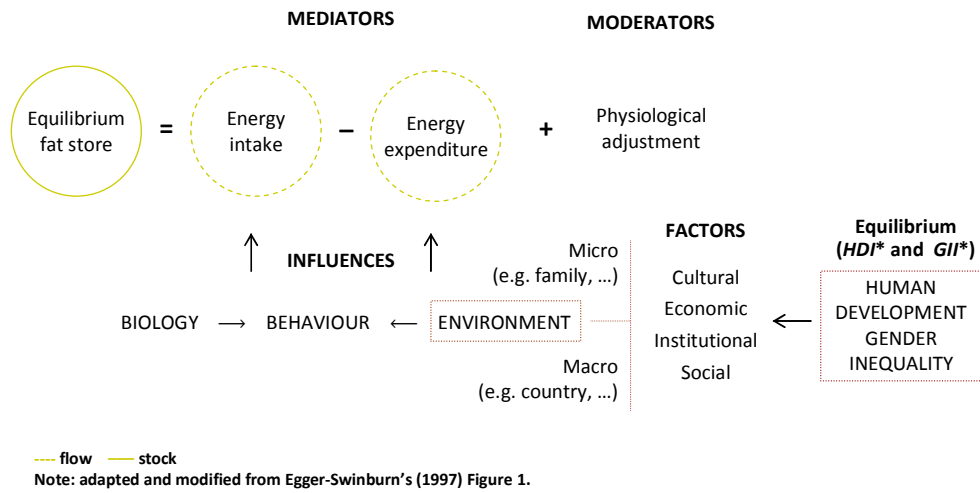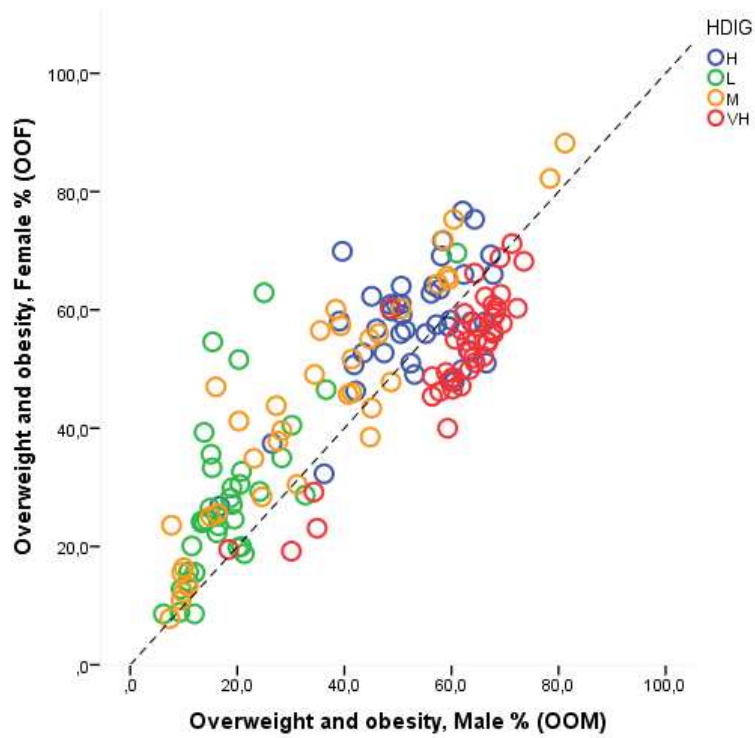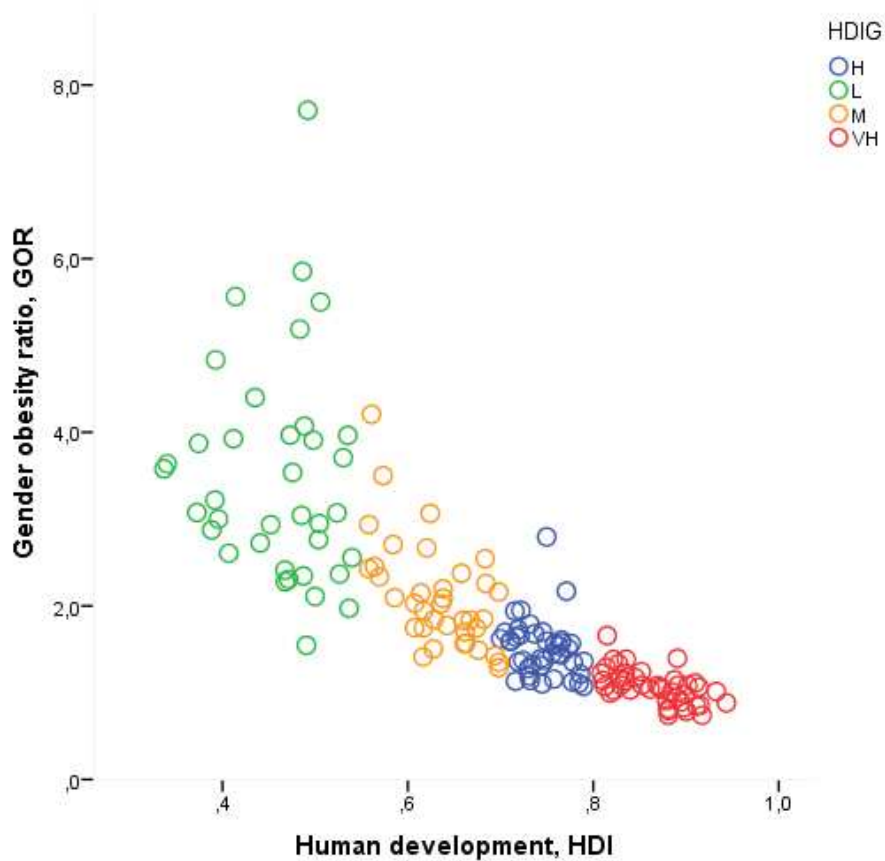**Figure 7. Human development (*HDI*) and the gender obesity ratio (*GOR*)**

Table 1. Spearman's rho correlation coefficients between *GOOR, GOR* and gender inequality indices.

		GOOR	GII	GDI	GGGI	GEI	SIGI	WEOI
GOOR	Correlation coefficient, ρ	1.000	0.802**	-0.483***	-0.341**	-0.546	0.512**	-0.702**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000
	n	159	139	138	134	143	102	118
		GOR	GII	GDI	GGGI	GEI	SIGI	WEOI
GOR	Correlation coefficient, ρ	1.000	0.888**	-0.653**	-0.400**	-0.629**	0.615**	-0.831**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000
	n	159	139	138	134	143	102	118

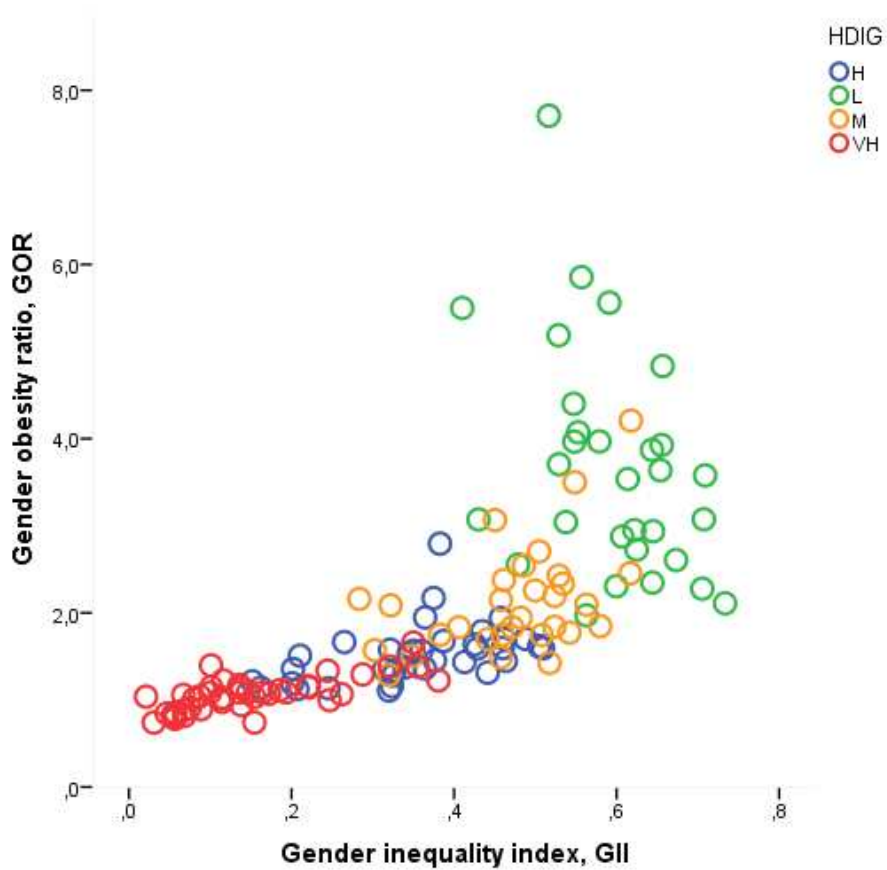***Correlation is significant at the 0.01 level (2-tailed).*

Figure 8. Gender inequality (*GII*) and gender disparities in obesity (*GOR*)
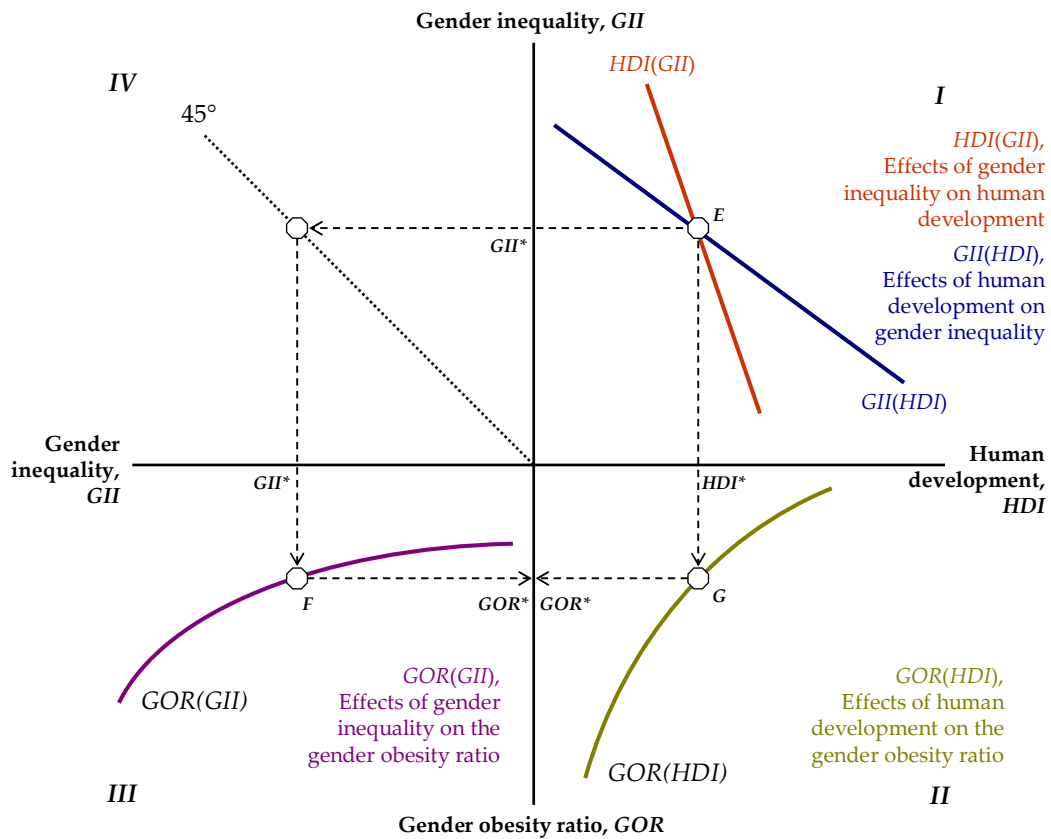

Figure 9. Human development, gender inequality and gender disparities in obesity.

Table 2. Regression results: using *GOR* as a proxy variable to predict gender inequality

	constant	Log(*GOR*)	Log(*GOR*)²	Adj. *R*²	*n*
1. Gender Inequality Index, *GII*	-2.08	2.75*	-1.14*	0.78	139
Std. Error		0.19	0.12		
t-Statistic		14.19	-9.62		
2. Gender Development Index, *GDI*	-0.01	-0.16*	0.05*	0.31	138
Std. Error		0.03	0.02		
t-Statistic		-4.93	2.36		
3. Global Gender Gap Index, *GGGI*	-0.31	0.23*	0.13*	0.29	134
Std. Error		0.03	0.02		
t-Statistic		-7.05	5.80		
4. Gender Equity Index, *GEI*	-0.32	-0.99	0.51	0.05	143
Std. Error		0.26	0.19		
t-Statistic		-3.80	2.76		
5. Social Institutions and Gender Index, *SIGI*	-4.17	4.90*	-2.07*	0.56	102
Std. Error		0.65	0.33		
t-Statistic		7.57	-6.24		
6. Women's Economic Opportunities Index, *WEOI*	-0.34	-0.85*	0.29*	0.65	118
Std. Error		0.08	0.06		
t-Statistic		-10.76	5.07		

Note: * = $p < 0.01$. Estimated using White's coefficient covariance matrix.

Table 3. Country ranking according to *GII* and *GOR*.

	Country	GII		Country	GOR
1	Slovenia	0.021	1	Switzerland	0.740
2	Switzerland	0.030	2	Luxembourg	0.741
3	Germany	0.046	3	Denmark	0.783
4	Sweden	0.054	4	Austria	0.795
5	Austria	0.056	5	Belgium	0.816
6	Denmark	0.056	6	Sweden	0.827
7	Netherlands	0.057	7	Germany	0.845
8	Italy	0.067	8	Netherlands	0.855
9	Norway	0.068	9	Norway	0.882
10	Belgium	0.068	**10**	Iceland	0.892
11	Finland	0.075	11	Finland	0.907
12	France	0.080	12	Japan	0.941
13	Czech Republic	0.087	13	Ireland	0.977
14	Iceland	0.088	14	Hungary	0.996
15	Spain	0.100	15	France	1.008
16	Korea (Republic of)	0.101	16	Australia	1.014
17	Israel	0.101	17	Portugal	1.025
18	Australia	0.113	18	Estonia	1.032
19	Ireland	0.115	19	Slovenia	1.037
20	Lithuania	0.116	**20**	Czech Republic	1.042

Countries that appear in only one ranking are in red.