

Best of 2019 Women

The deadly truth about a world built for men - from stab vests to car crashes



▲ It wasn't until 2011 that the US started using a female crash-test dummy. Photograph: Kellie French/The Guardian

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When broadcaster Sandi Toksvig was studying anthropology at university, one of her female professors held up a photograph of an antler bone with 28 markings on it. “This,” said the professor, “is alleged to be man’s first attempt at a calendar.” Toksvig and her fellow students looked at the bone in admiration. “Tell me,” the professor continued, “what man needs to know when 28 days have passed? I suspect that this is woman’s first attempt at a calendar.”

Women have always tracked their periods. We’ve had to. Since 2015, I’ve been reliant on a period tracker app, which reassures me that there’s a

been reliant on a period tracker app, which reassures me that there's a reason I'm welling up just thinking about Andy Murray's "casual feminism". And then there's the issue of the period itself: when you will be bleeding for up to seven days every month, it's useful to know more or less when those seven days are going to take place. Every woman knows this, and Toksvig's experience is a neat example of the difference a female perspective can make, even to issues that seem entirely unrelated to gender.

For most of human history, though, that perspective has not been recorded. Going back to the theory of Man the Hunter, the lives of men have been taken to represent those of humans overall. When it comes to the other half of humanity, there is often nothing but silence. And these silences are everywhere. Films, news, literature, science, city planning, economics, the stories we tell ourselves about our past, present and future, are all marked - disfigured - by a female-shaped "absent presence". This is the gender data gap.

These silences, these gaps, have consequences. They impact on women's lives, every day. The impact can be relatively minor - struggling to reach a top shelf set at a male height norm, for example. Irritating, certainly. But not life-threatening. Not like crashing in a car whose safety tests don't account for women's measurements. Not like dying from a stab wound because your police body armour doesn't fit you properly. For these women, the consequences of living in a world built around male data can be deadly.

The gender data gap is both a cause and a consequence of the type of unthinking that conceives of humanity as almost exclusively male. In the 1956 musical *My Fair Lady*, phoneticist Henry Higgins is baffled when, after enduring months of his hectoring put-downs, his protege-cum-victim Eliza Doolittle finally bites back. "Why can't a woman be more like a man?" he grumbles.

When 'women's work' is deadly

The formula to determine standard office temperature was developed in the 1960s around the metabolic resting rate of the average man. But a recent Dutch study found that the metabolic rate of young adult females performing light office work is significantly lower than the standard values for men doing the same activity. In fact, the formula may **overestimate female metabolic rate by as much as 35%**, meaning that current offices are on average five degrees too cold for women. This leads to the **odd sight of female office workers wrapped in blankets** in the summer, while their male colleagues wander around in shorts.

Not only is this situation inequitable, it is bad business sense: an uncomfortable workforce is an unproductive workforce. But workplace data gaps lead to a lot worse than simple discomfort and inefficiency. Over the past 100 years, workplaces have, on the whole, got considerably safer. In the early 1900s, **about 4,400 people in the UK died at work** every year. By 2016, **that figure had fallen** to 135. But while serious injuries at work have been decreasing for men, **there is evidence** that they have been increasing among women. The gender data gap is again implicated, with occupational research traditionally focused on male-dominated industries.

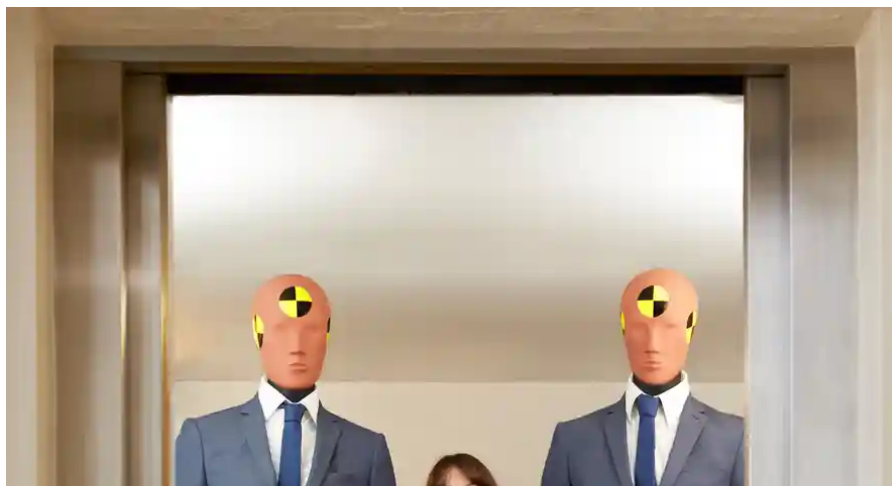
Every year, 8,000 people in the UK **die from work-related cancers**. And although most research in this area has been done on men, it's far from

clear that men are the most affected. Over the past 50 years, breast cancer rates in the industrialised world have risen significantly – but a failure to research female bodies, occupations and environments means that the data for exactly what is behind this rise is lacking. “We know everything about dust disease in miners,” Rory O’Neill, professor of occupational and environmental policy research at the University of Stirling, tells me. “You can’t say the same for exposures, physical or chemical, in ‘women’s work’.”

Cancer is a long-latency disease, O’Neill says, so even if we started the studies now, it would take a working generation before we had any usable data. But we aren’t starting the studies now. Instead, we continue to rely on data from studies done on men as if they apply to women. Specifically, Caucasian men aged 25 to 30, who weigh 70kg. **This is “Reference Man”** and his superpower is being able to represent humanity as a whole. Of course, he does not.

Men and women have different immune systems and hormones, which can play a role in how chemicals are absorbed. Women tend to be smaller than men and have thinner skin, both of which can lower the level of toxins they can be safely exposed to. This lower tolerance threshold is compounded by women’s higher percentage of body fat, in which some chemicals can accumulate. Chemicals are still usually tested in isolation, and on the basis of a single exposure. But this is not how women tend to encounter them.

In nail salons, where the workforce is almost exclusively female (and often migrant), workers will be exposed on a daily basis to a huge range of chemicals that are “routinely found in the polishes, removers, gels, shellacs, disinfectants and adhesives that are staples of their work”, according to the Canadian researcher Anne Rochon Ford. **Many of these chemicals have been linked to** cancer, miscarriages and lung diseases. Some may alter the body’s normal hormonal functions. If these women then go home and begin a second unpaid shift cleaning their home, they will be exposed to different chemicals that are ubiquitous in common products. The effects of these mixing together are largely unknown.





▲ 'Serious injuries at work are increasing among women.' Model: Nina Trickey. Hair and makeup: Vale Von Der Wehl using Laura Mercier and Kerastase. Assistant: Bruce Horak. Dummies: courtesy of Cellbond. Photograph: Kellie French/The Guardian

Most of the research on chemicals has focused on their absorption through the skin. But many of the ones used in nail salons are extremely volatile, which means that they evaporate at room temperature and can be inhaled – along with the considerable amounts of dust produced when acrylic nails are filed. The research on how this may impact on workers is virtually nonexistent.

Part of the failure to see the risks in traditionally female-dominated industries is because often these jobs are an extension of what women do in the home (although at a more onerous scale). But the data gap when it comes to women in the workplace doesn't only arise in female-dominated industries.

Little data exists on injuries to women in construction, but the [New York Committee for Occupational Safety & Health \(NYCOSH\)](#) points to a US study of union carpenters that found women had higher rates of sprains, strains and nerve conditions of the wrist and forearm than men. Given the

lack of data, it's hard to be sure exactly why this is, but it's a safe bet to attribute at least some of the blame to "standard" construction site equipment being designed around the male body.

“ A female police officer had to have breast-reduction surgery because of the health effects of wearing her body armour

Wendy Davis, ex-director of the Women's [Design](#) Service in the UK, questions the standard size of a bag of cement. It's a comfortable weight for a man to lift – but it doesn't actually have to be that size, she points out. “If they were a bit smaller, then women could lift them.” Davis also takes issue with the standard brick size. “I've got photographs of my [adult] daughter holding a brick. She can't

get her hand round it. But [her husband] Danny's hand fits perfectly comfortably. Why does a brick have to be that size?" She also notes that the typical A1 architect's portfolio fits nicely under most men's arms while most women's arms don't reach round it.

NYCOSH similarly notes that "standard hand tools like wrenches tend to be too large for women's hands to grip tightly".

In the UK, employers are legally required to provide well-maintained personal protective equipment (PPE) - anything from goggles to full body suits - to workers who need it, free of charge. But most PPE is based on the sizes and characteristics of male populations from Europe and the US. The TUC found that employers often think that when it comes to female workers all they need to do to comply with this legal requirement is to buy smaller sizes.

Differences in chests, hips and thighs can affect the way the straps fit on safety harnesses. [The use of a "standard" US male face shape for dust, hazard and eye masks](#) means they don't fit most women (as well as a lot of black and minority ethnic men). A 2017 TUC report [found that the problem with ill-fitting PPE](#) was worst in the emergency services, where only 5% of women said that their PPE never hampered their work, with body armour, stab vests, hi-vis vests and jackets all highlighted as unsuitable.

When it comes to frontline workers, poorly fitting PPE can prove fatal. In 1997, a British female police officer was stabbed and killed while using a hydraulic ram to enter a flat. She had removed her body armour because it was too difficult to use the ram while wearing it. Two years later, a female police officer revealed that she had had to have breast-reduction surgery because of the health effects of wearing her body armour. After this case was reported, another [700 officers in the same force](#) came forward to complain about the standard-issue protective vest.

But although the complaints have been coming regularly over the past 20 years, little seems to have been done. British female police officers report being bruised by their kit belts; a number have had to have physiotherapy because of the way stab vests sit on their body; many complain there is no space for their breasts. This is not only uncomfortable, it also results in stab vests coming up too short, leaving women unprotected.

The tyranny of the toilet queue

In April 2017, the BBC journalist Samira Ahmed wanted to use a toilet. She was at a screening of the James Baldwin documentary I Am Not Your Negro at London's Barbican arts centre, and it was the interval. Any woman who has ever been to the theatre knows what that means. This

evening, the queue was worse than usual. Far worse. Because in an almost comically blatant display of not having thought about women at all, the Barbican had turned both the male and female toilets gender neutral simply by replacing the "men" and "women" signage with "gender neutral with urinals" and "gender neutral with cubicles". The obvious happened. Only men were using the supposedly "gender neutral with urinals" and everyone was using the "gender neutral with cubicles".

Rather than rendering the toilets genuinely gender neutral, they had simply increased the provision for men. "Ah the irony of having to explain discrimination having just been to see I Am Not Your Negro IN YOUR CINEMA", [Ahmed tweeted](#), suggesting that turning the gents gender neutral would be sufficient: "There's NEVER such a queue there & you

know it.”

On the face of it, it may seem fair and equitable to accord male and female public toilets the same amount of space - and historically, this is the way it has been done: 50/50 division of floor space has even been formalised in plumbing codes. However, if a male toilet has both cubicles and urinals, the number of people who can relieve themselves at once is far higher per square foot of floor space in the male bathroom than in the female bathroom. Suddenly equal floor space isn't so equal.

But even if male and female toilets had an equal number of stalls, the issue wouldn't be resolved, because women take up to 2.3 times as long as men to use the toilet. Women make up the majority of the elderly and disabled, two groups that will tend to need more time in the toilet. Women are also more likely to be accompanied by children, as well as disabled and older people. Then there's the 20-25% of women of childbearing age who may be on their period at any one time, and therefore need to change a tampon or a sanitary pad.

Women may also require more trips to the bathroom: pregnancy significantly reduces bladder capacity, and women are eight times more likely to suffer from urinary-tract infections. In the face of all these anatomical differences, it would surely take a formal equality dogmatist to continue to argue that equal floor space between men and women is fair.

The gadgets built for one-size-fits-men

In 1998, a pianist called Christopher Donison wrote that “one can divide the world into roughly two constituencies”: those with larger hands, and those with smaller hands. Donison was writing as a male pianist who, due to his smaller than average hands, had struggled for years with traditional keyboards, but he could equally have been writing as a woman. There is plenty of data showing that women have, on average, smaller hands, and yet we continue to design equipment around the average male hand as if one-size-fits-men is the same as one-size-fits-all.

The average smartphone size is now 5.5 inches. While the average man can fairly comfortably use his device one-handed, the average woman's hand is not much bigger than the handset itself. This is obviously annoying - and foolish for a company like Apple, given that research shows [women are more likely to own an iPhone than men](#).

“ One woman found her car's voice-command system only listened to her

husband, even though he was in the passenger seat

The tech journalist and author James Ball has a theory for why the big-screen fixation persists: because the received wisdom is that men drive high-end smartphone purchases. But if

women aren't driving high-end smartphone purchases - at least for non-Apple products - is it because women aren't interested in smartphones? Or could it be because smartphones are designed without women in

mind? On the bright side, Ball reassured me that screens probably wouldn't be getting any bigger because “they've hit the limit of men's hand size”.

Good news for men, then. But tough breaks for women like my friend Liz who owns a third-generation Motorola Moto G. In response to one of my regular rants about handset sizes she replied that she'd just been “complaining to a friend about how difficult it was to zoom on my phone

camera. He said it was easy on his. Turns out we have the same phone. I wondered if it was a hand-size thing.”

When Zeynep Tufekci, a researcher at the University of North Carolina, was trying to document tear gas use in the Gezi Park protests in Turkey in 2013, the size of her Google Nexus got in the way. It was the evening of 9 June. Gezi Park was crowded. Parents were there with their children. And then the canisters were fired. Because officials “often claimed that tear gas was used only on vandals and violent protesters”, Tufekci wanted to document what was happening. So she pulled out her phone. “And as my lungs, eyes and nose burned with the pain of the lachrymatory agent released from multiple capsules that had fallen around me, I started cursing.” Her phone was too big. She could not take a picture one-handed – “something I had seen countless men with larger hands do all the time”. All Tufekci’s photos from the event were unusable, she wrote, and “for one simple reason: good smartphones are designed for male hands”.

Voice recognition could be one solution to a smartphone that doesn’t fit your hands, but voice-recognition software is often hopelessly male-biased. In 2016, Rachael Tatman, a research fellow in linguistics at the University of Washington, [found that Google’s speech-recognition software](#) was 70% more likely to accurately recognise male speech.

Clearly, it is unfair for women to pay the same price as men for products that deliver an inferior service. But there can also be serious safety implications. Voice-recognition software in cars, for example, is meant to decrease distractions and make driving safer. But they can have the opposite effect if they don’t work. [An article on car website Autoblog](#) quoted a woman who had bought a 2012 Ford Focus, only to find that its voice-command system only listened to her husband, even though he was in the passenger seat. Another woman called the manufacturer for help when her Buick’s voice-activated phone system wouldn’t listen to her: “The guy told me point-blank it wasn’t ever going to work for me. They told me to get a man to set it up.”

Immediately after writing this, I was with my mother in her Volvo Cross Country watching her try and fail to get the voice-recognition system to call her sister. After five failed attempts I suggested she tried lowering the pitch of her voice. It worked first time.

In the tech world, the implicit assumption that men are the default human remains king. When Apple launched its health-monitoring system with much fanfare in 2014, it boasted a “comprehensive” health tracker. It could track blood pressure; steps taken; blood alcohol level; even

molybdenum and copper intake. But as many women pointed out at the time, they forgot one crucial detail: a period tracker.

When Apple launched their AI, Siri, users in the US found that she (ironically) could find [prostitutes and Viagra suppliers, but not abortion providers](#). Siri could help you if you’d had a heart attack, but if you told her you’d been raped, she replied “I don’t know what you mean by ‘I was raped.’”

From smartwatches that are too big for women’s wrists, to map apps that fail to account for women who may want to know the “safest” in addition to “fastest” routes; to “measure how good you are at sex” apps called “iThrust” and “iBang” the tech industry is rife with other examples. While there are an increasing number of female-led tech firms that do cater to

there are an increasing number of female-led tech firms that do cater to women's needs, they are seen as a "niche" concern and often struggle to get funding.

One study of 12 [of the most common fitness monitors found that](#) they underestimated steps during housework by up to 74% (that was the Omron, which was within 1% for normal walking or running) and underestimated calories burned during housework by as much as 34%. Meanwhile, Fitbit users have complained that the device fails to account for movement while doing the extremely common female activity of pushing a pram (and, yes, men push prams, too; but not as often as the women who do 75% of the world's unpaid care).

How women are put at risk on the roads

Men are more likely than women to be involved in a car crash, which means they dominate the numbers of those seriously injured in them. But [when a woman is involved in a car crash, she is 47% more likely to be seriously injured](#), and 71% more likely to be moderately injured, even when researchers control for factors such as height, weight, seatbelt usage, and crash intensity. [She is also 17% more likely to die](#). And it's all to do with how the car is designed - and for whom.

Women tend to sit further forward when driving. This is because we are on average shorter. Our legs need to be closer to reach the pedals, and we need to sit more upright to see clearly over the dashboard. This is not, however, the "standard seating position", researchers have noted. [Women are "out of position" drivers](#). And our wilful deviation from the norm means that we are at greater risk of internal injury on frontal collisions. The angle of our knees and hips as our shorter legs reach for the pedals also makes our legs more vulnerable. Essentially, we're doing it all wrong.

“ Cars have been designed using car crash-test dummies based on the 'average' male

Women are also at higher risk in rear-end collisions. We have less muscle on our necks and upper torso, which make us more vulnerable to whiplash (by up to three times), and car design has amplified this vulnerability. [Swedish research has shown](#) that modern seats are too firm to protect women against

whiplash injuries: the seats throw women forward faster than men because the back of the seat doesn't give way for women's on average lighter bodies. The reason this has been allowed to happen is very simple: cars have been designed using car crash-test dummies based on the "average" male.

Crash-test dummies were first introduced in the 1950s, and for decades they were based around the 50th-percentile male. The most commonly used dummy is 1.77m tall and weighs 76kg (significantly taller and heavier than an average woman); the dummy also has male muscle-mass proportions and a male spinal column. [In the early 1980s, researchers based at Michigan University](#) argued for the inclusion of a 50th-percentile female in regulatory tests, but this advice was ignored by manufacturers and regulators. It wasn't until 2011 that the US started using a female crash-test dummy - although, as we'll see, just how "female" these dummies are is questionable.

In 2018, Astrid Linder, research director of traffic safety at the Swedish National Road and Transport Research Institute, presented a paper at the

Road Safety on Five Continents Conference in South Korea, in which she ran through EU regulatory crash-test requirements. In no test is an anthropometrically correct female crash-test dummy required. The seatbelt test, one of the frontal-collision tests, and both lateral-collision tests all specify that a [50th-percentile male dummy should be used](#). There is one EU regulatory test that requires what is called a 5th-percentile female dummy, which is meant to represent the female population. Only 5% of women will be shorter than this dummy. But there are a number of data gaps. For a start, [this dummy is only tested in the passenger seat](#), so we have no data at all for how a female driver would be affected - something of an issue you would think, given women's "out of position" driving style. And secondly, this female dummy is not really female. It is just a scaled-down male dummy.

Consumer tests can be slightly more stringent than regulatory ones. The 2011 introduction of female crash-test dummies in the US sent cars' star ratings plummeting. When I spoke to EuroNCAP, a European organisation that provides car safety ratings for consumers, they said that since 2015 they have used male and female dummies in both front-crash tests, and that they base their female dummies on female anthropometric data - with the caveat that this is "where data is available". EuroNCAP acknowledged that "sometimes" they do just use scaled-down male dummies. But women are not scaled-down men. We have different muscle mass distribution. We have lower bone density. There are differences in vertebrae spacing. Even our body sway is different. And these differences are all crucial when it comes to injury rates in car crashes.

The situation is even worse for pregnant women. Although a pregnant crash-test dummy was created back in 1996, testing with it is still not government-mandated either in the US or in the EU. In fact, even though car crashes are the No 1 cause of foetal death related to maternal trauma, we haven't yet developed a seatbelt that works for pregnant women. Research from 2004 suggests that pregnant women should use the standard seatbelt; but 62% of third-trimester pregnant women don't fit that design.

Linder has been working on what she says will be the first crash-test dummy to accurately represent female bodies. Currently, it's just a prototype, but she is calling on the EU to make testing on such dummies a legal requirement. In fact, Linder argues that this already is a legal requirement, technically speaking. Article 8 of the Treaty of the Functioning of the European Union reads, "In all its activities, the Union shall aim to eliminate inequalities, and to promote equality, between men

and women." Clearly, women being 47% more likely to be seriously injured in a car crash is one hell of an inequality to overlook.

Designers may believe they are making products for everyone, but in reality they are mainly making them for men. It's time to start designing women in.

This is an edited extract from [Invisible Women: Exposing Data Bias in a World Designed for Men](#) by Caroline Criado Perez (Chatto & Windus, £16.99). To order a copy go to guardianbookshop.com. Free UK p&p on all online orders over £15.

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Despite my name I'm actually female and have worked in typically male jobs requiring safety equipment, namely goggles, breathing masks and ear protectors, all of which didn't fit properly. Using an angle grinder to cut paving stones, my ill fitting breathing mask,(gas mask like , not the light papery ones (which are also too big) while not slipping down would send my breath up under the goggles that didn't fit and would slip, steaming them up,...

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