

# NTT DOCOMO

# Impact Valuation Report

**Driver-Pressure-State-Impact-Response**  
**Societal Benefits Of NTT Docomo's Select Services**

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# Executive Summary

**Driver-Pressure-State-Impact-Response**  
**Societal Benefits Of NTT Docomo's Select Services**

# Master Executive Summary

The 'Driver – Pressure – State – Impact – Response' framework helps structure and illuminate previously unquantified and unvalued positive externalities

These quantified externalities comprise a portion the of wider societal benefits provided by NTT Docomo

These quantified externalities represent dimensions of NTT Docomo's **Value To Japanese Society**

Four analyses were performed concerning three services:

- Mobile Phone Safety Classes For Elementary To High School Students -
- Mobile Phone Safety Class For Senior Citizens -
- Mobile Application That Encourages Users To Increase Their Daily Step Count -

The social benefits of these services are necessarily calculated over different time periods

**That Said ...**

**... In Their First Year, The Total Societal Benefit Of All Services Is Equal To c. JPY 3 Billion**

# Value To Society of NTT Docomo's Select Services

## Summary Tables

The table below shows the broad attributes of each of the studies. For example, there is a disproportionate temporal distribution of social costs across the studies. The child abuse study has the greatest depth in terms of social costs avoided and the time horizon of experience. This table serves as a point from which future areas of improvement can be made.

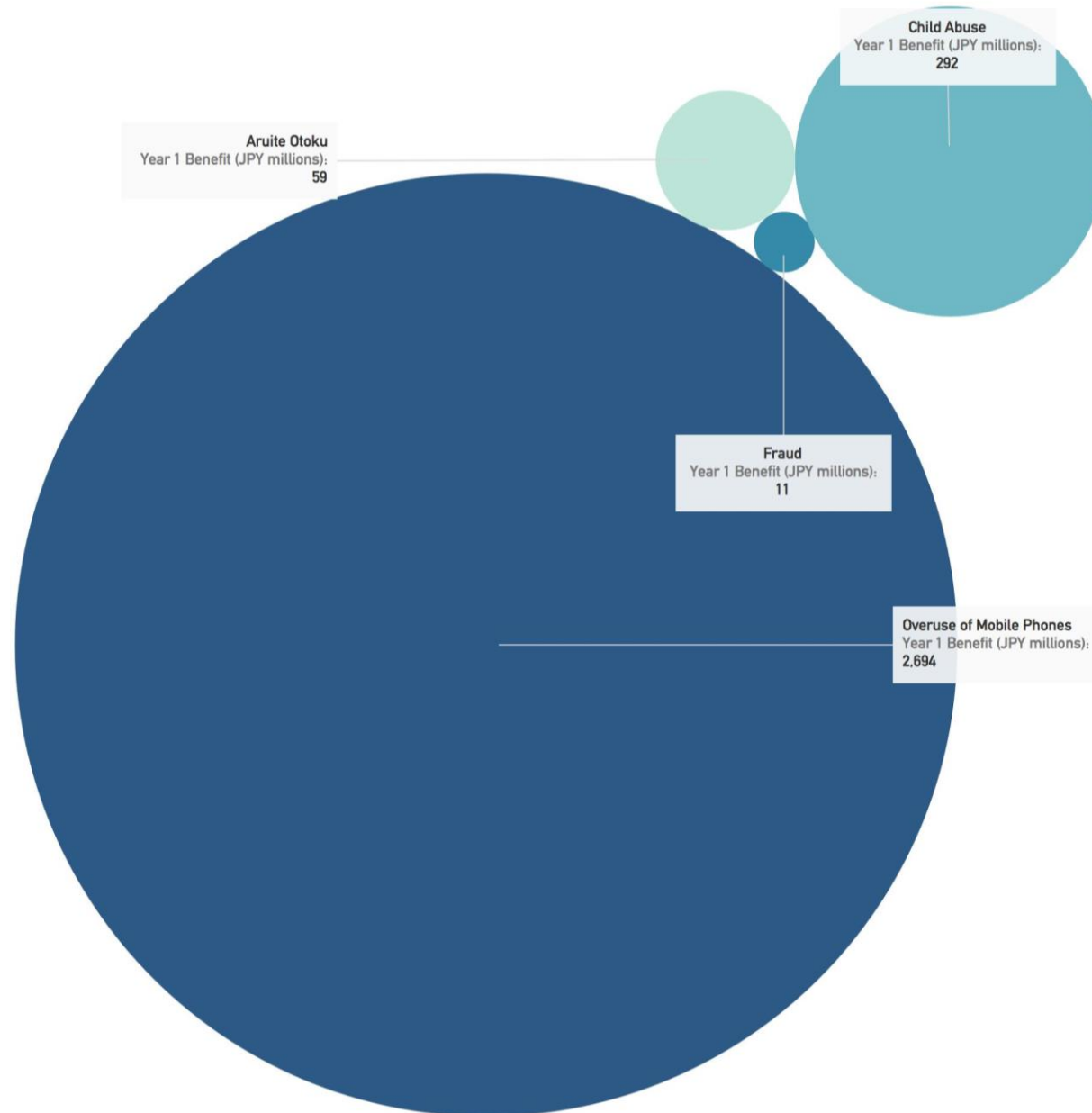
Study	Number of Costs/ Benefits	Number of Indirect Costs / Benefits	Number of Direct Costs / Benefits	Time Series of Cost / Benefit (Years)
Child Abuse	32	14	18	45
Fraud	2	0	2	1
Overuse of Mobile Phones	1	0	1	0.5
Aruite Otoku	4	3	1	1
<b>Total</b>	<b>39</b>	<b>17</b>	<b>22</b>	<b>N/A</b>

The table below compares the social benefits of the different studies. The most useful comparisons are found in the benefit per user and benefit per participant columns. The benefit per participant will be distorted by the number of participants as the benefit is distributed across e.g. non-victims and victims alike. Further, the benefit per beneficiary might be distorted by the number of costs. These figures are presented graphically over the following pages.

Study	Total Benefit (JPY millions)	Year 1 Benefit (JPY millions)	Users / Participants (#)	Benefit per User / Participant (JPY)	Beneficiaries (#)	Benefit per Beneficiary (JPY)
Child Abuse	2,800	292	1,032,668	2,711	248	11,290,323
Fraud	11	11	8,497	1,318	3	3,589,744
Overuse of Mobile Phones	1,347	1,347	742,467	1,814	64,027	21,037
Aruite Otoku	59	59	48,653	1,213	19,346	3,050
<b>Total</b>	<b>2,965</b>	<b>1,709</b>	<b>1,832,285</b>	<b>N/A</b>	<b>83,624</b>	<b>N/A</b>
<b>Average</b>	<b>741</b>	<b>114</b>	<b>458,071</b>	<b>1,342</b>	<b>20,906</b>	<b>3,721,148</b>

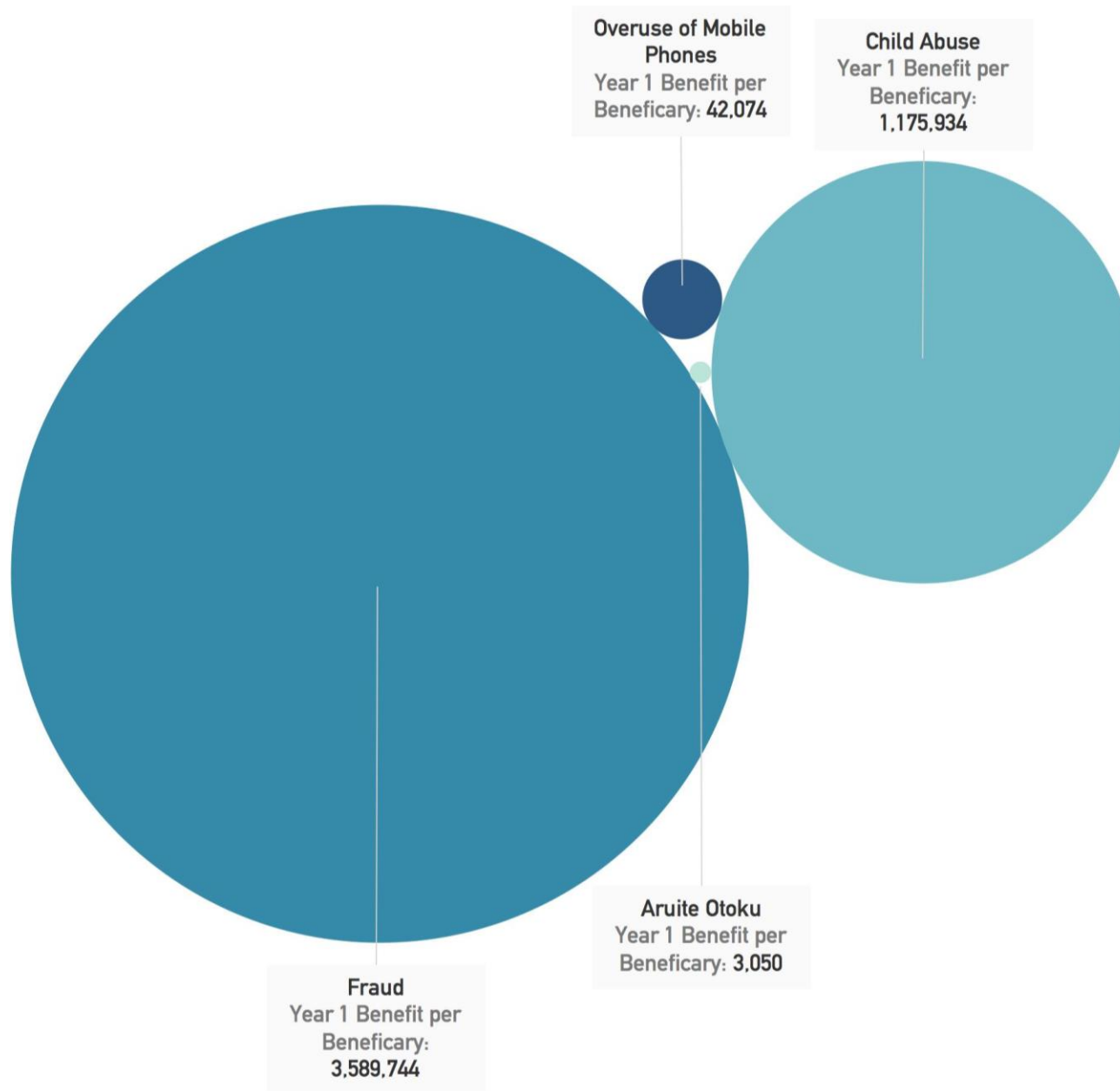
# Value To Society of NTT Docomo's Select Services

## Year 1 Societal Benefits Of Select Services



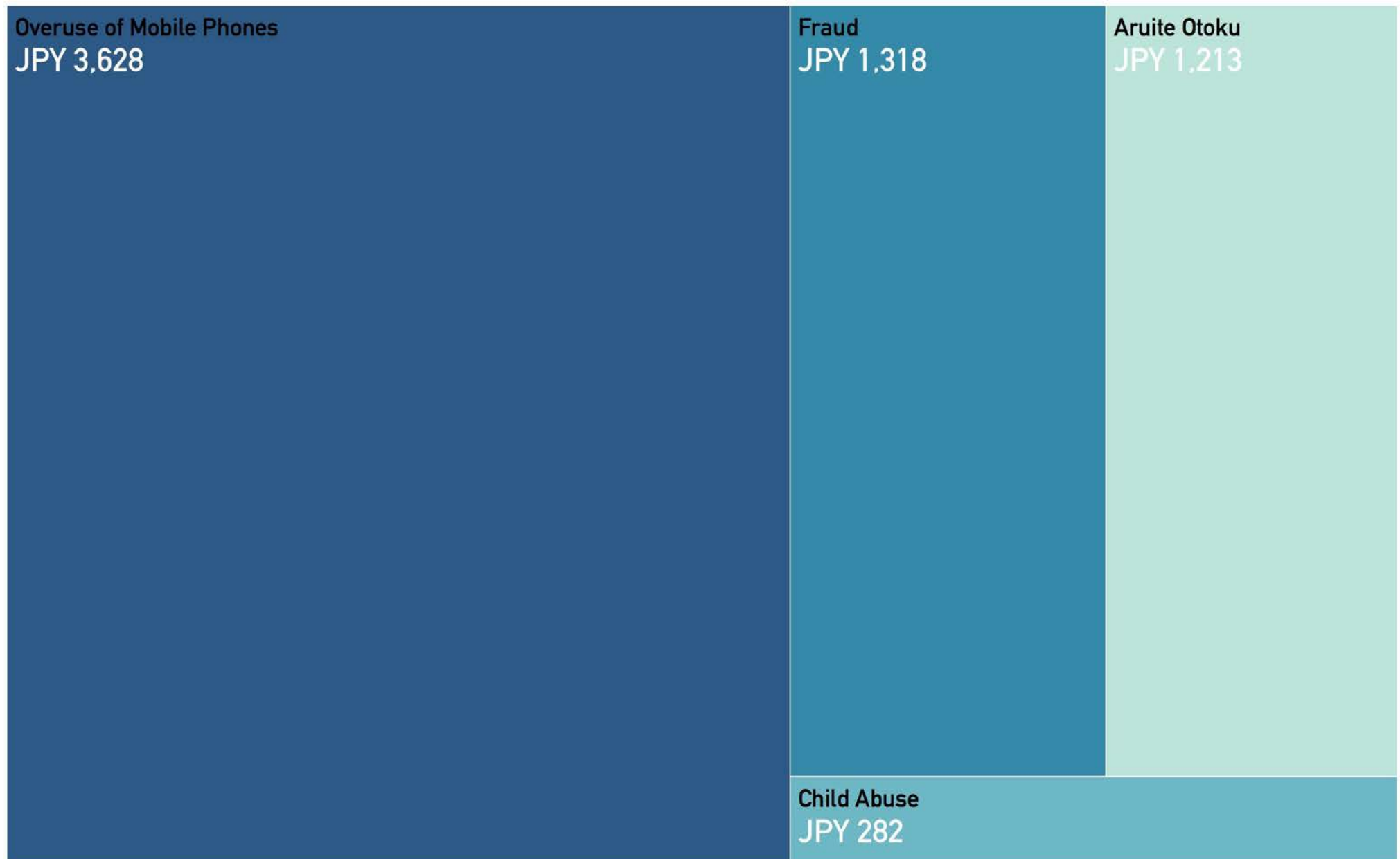
# Value To Society of NTT Docomo's Select Services

## Year 1 Societal Benefits Of Select Services Per Beneficiary



# Value To Society of NTT Docomo's Select Services

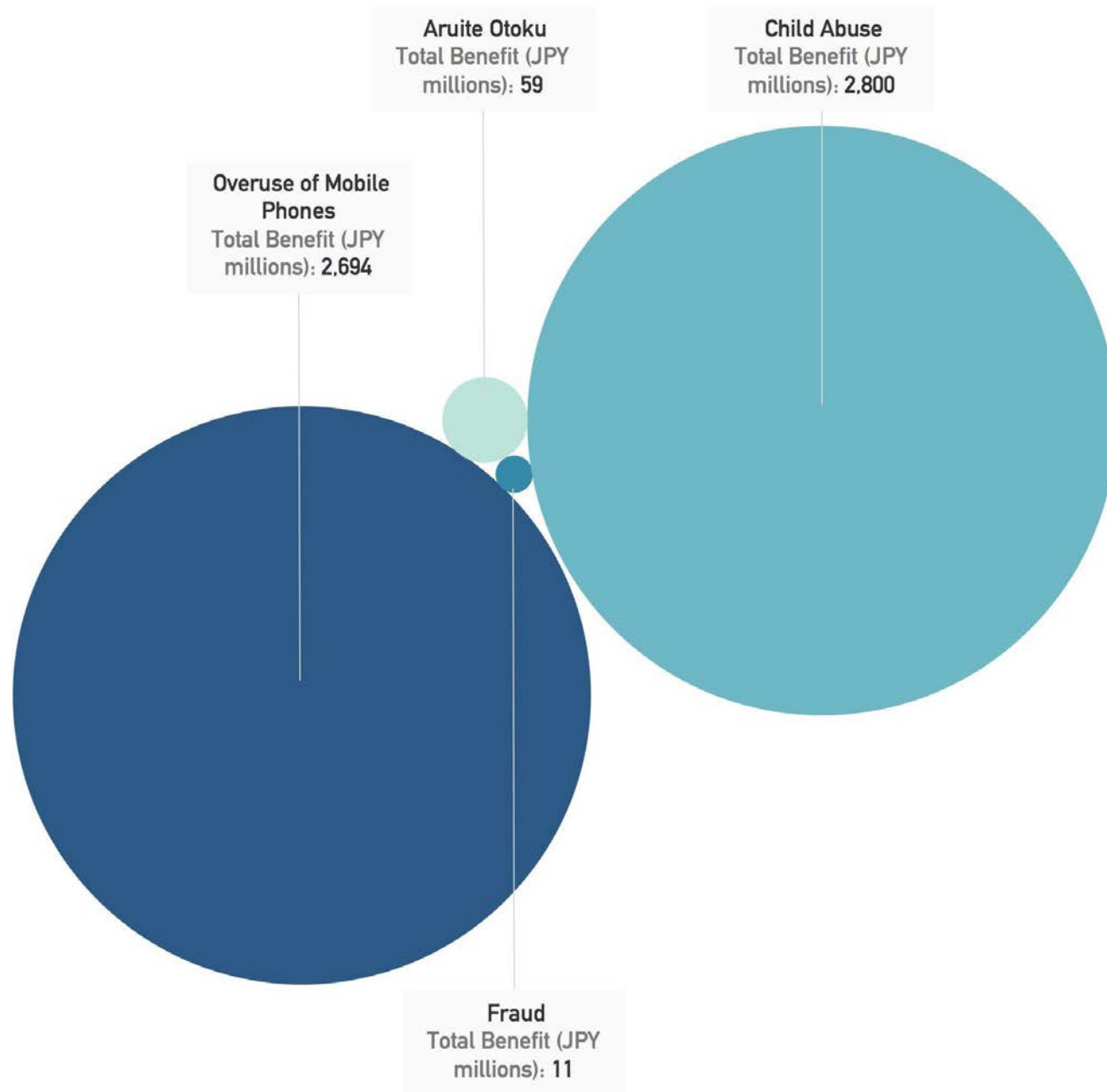
Year 1 Societal Benefits Of Select Services Per Class Participant / App User





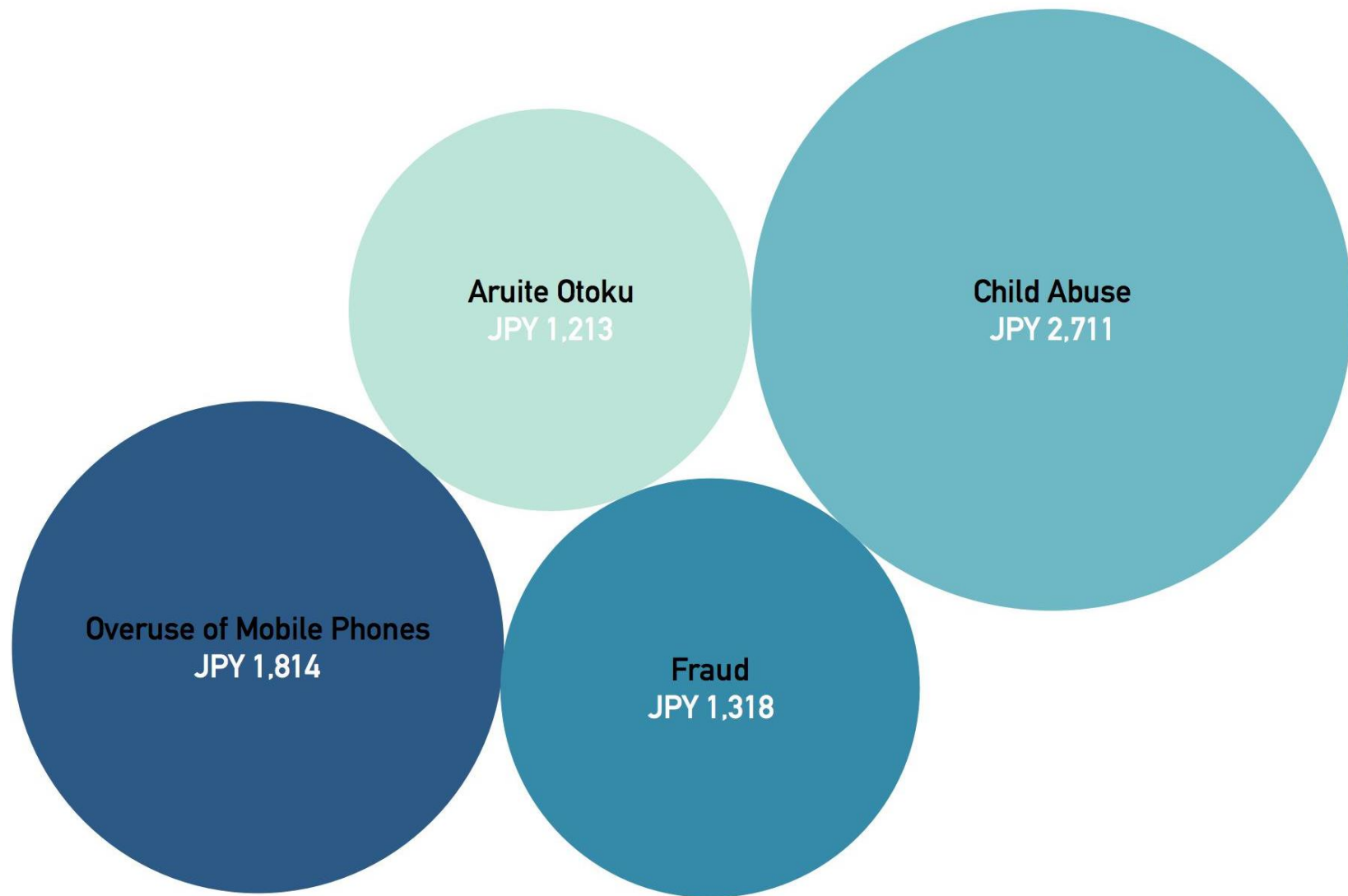
# Value To Society of NTT Docomo's Select Services

## Total Societal Benefit



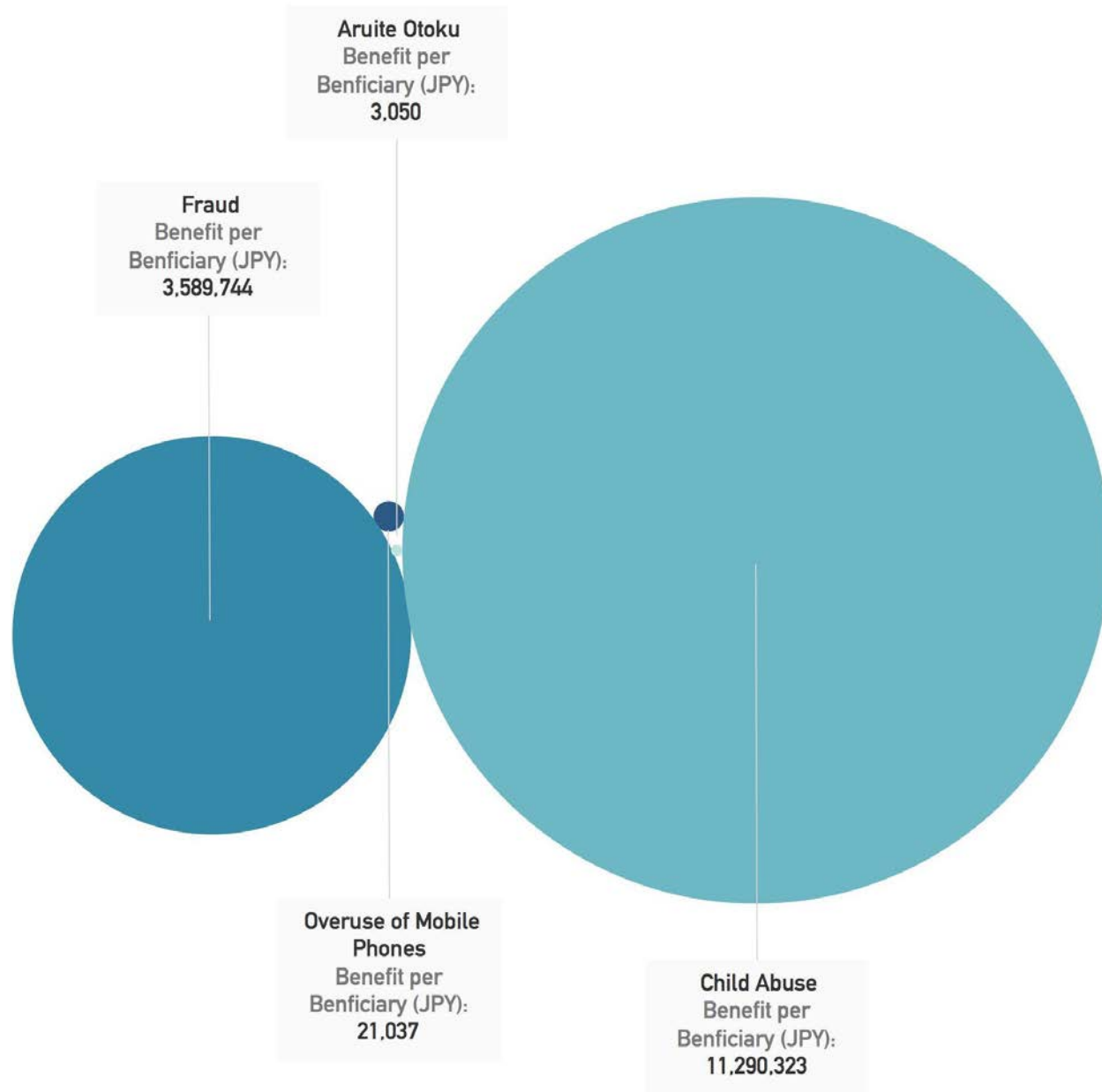
# Value To Society of NTT Docomo's Select Services

Total Societal Benefit Per Participant / App User



# Value To Society of NTT Docomo's Select Services

## Total Societal Benefit Per Beneficiary



## Concluding Remarks

All studies share a common limitation concerning lack of depth and due to varying cost time horizons and cost components inter-comparison is difficult.

That said, the analysis for and conclusions of each study are provoking, in that they shed light on the economic implications of, typically, non-financial indicators.

There is much that can be improved upon concerning each study, further research and analysis would be best directed to a more focused assessment of one service or product.

# 1. Societal Benefits Of Avoided Child Abuse Through Mobile Phone Safety Class

**Driver-Pressure-State-Impact-Response**  
**Societal Benefits Of NTT Docomo's Select Services**

# Executive Summary

- In 2015, [1,509] Japanese children were targeted via their mobile phones by sexual predators and became victims of prostitution, pornography or molestation. It is an increasing trend
- Those children will carry the burden of trauma for their lifetime. They are more likely to suffer mental disorders, fall into crime, leave education & commit suicide. The burden is destructive and protracted
- The conservative Net Present Value [NPV] of the social cost of this abuse equals [JPY 18 Billion]
  - Over 45 years at 3 per cent discount rate
- Interventions to prevent and mitigate these abuses are morally and economically absolutely necessary. NTT Docomo's 'Mobile Phone Safety Class' is an example of a preventative intervention
- NTT Docomo's 'Mobile Phone Safety Class' in 2016 is estimated to have prevented [248] potential victims of child abuse by educating [1 million+ students] on the risks of mobile phone use
- This has a social benefit valued at [JPY 2.8 billion]; a measure of the avoided socio-economic costs of many lifetimes of trauma and one dimension of NTT Docomo's Value To Japanese Society
- The following slides will detail how this conclusion was reached

# Overview

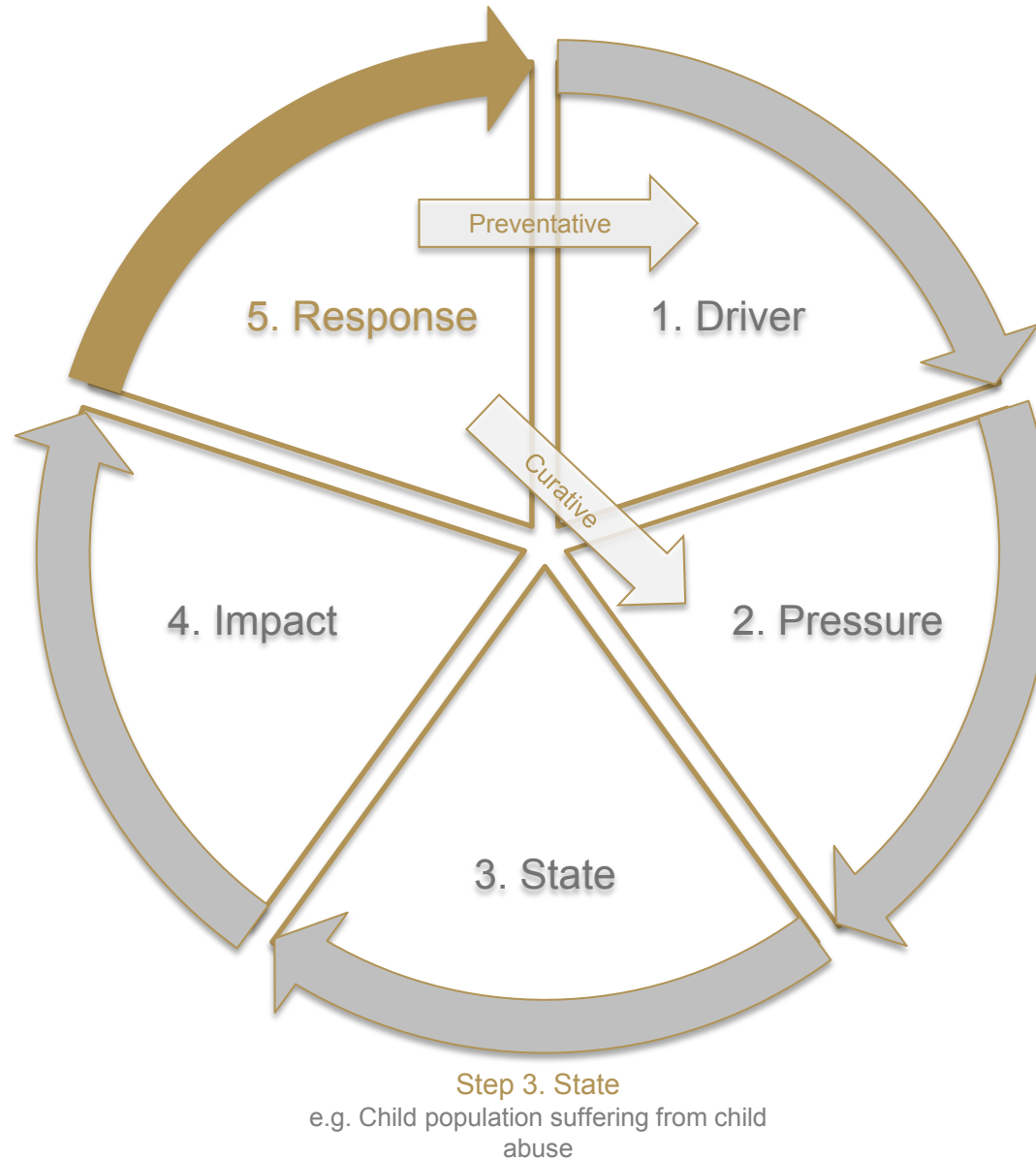
## Driver-Pressure-State-Impact-Response [DPSIR]

**Step 5: Response**  
e.g. Mobile phone safety classes prevent participants from being exploited by educating them on the prevailing risks and ways to mitigate them

**Step 1: Driver**  
e.g. Increase in mobile phone use

**Step 2: Pressure**  
e.g. Increasing levels of child abuse as offenders have access to more channels with which they can exploit children from a distance

**Step 4: Impact**  
e.g. The socio-economic impacts of child abuse



**Step 3: State**  
e.g. Child population suffering from child abuse

- the DPSIR approach is non-linear, reflecting the cyclical nature of socio-economic impacts and their respective drivers -

# Flow of Analysis

## DRIVER

Evidence of the increasing use of mobile phones amongst children and the adult population increases opportunities for potential offenders to contact and find victims

## PRESSURE

Evidence of the increasing number of child abuse cases at the national level both related to and unrelated to mobile phone use, including increasing trends in child pornography

## STATE

Evidence of the current reported figures of child abuse that was engendered via mobile phones  
These are the figures that are pertinent to the analysis and a prevalence rate has been calculated from it

## IMPACT

Assessment and evaluation of the socio-economic costs associated with child abuse direct, indirect, short and long term

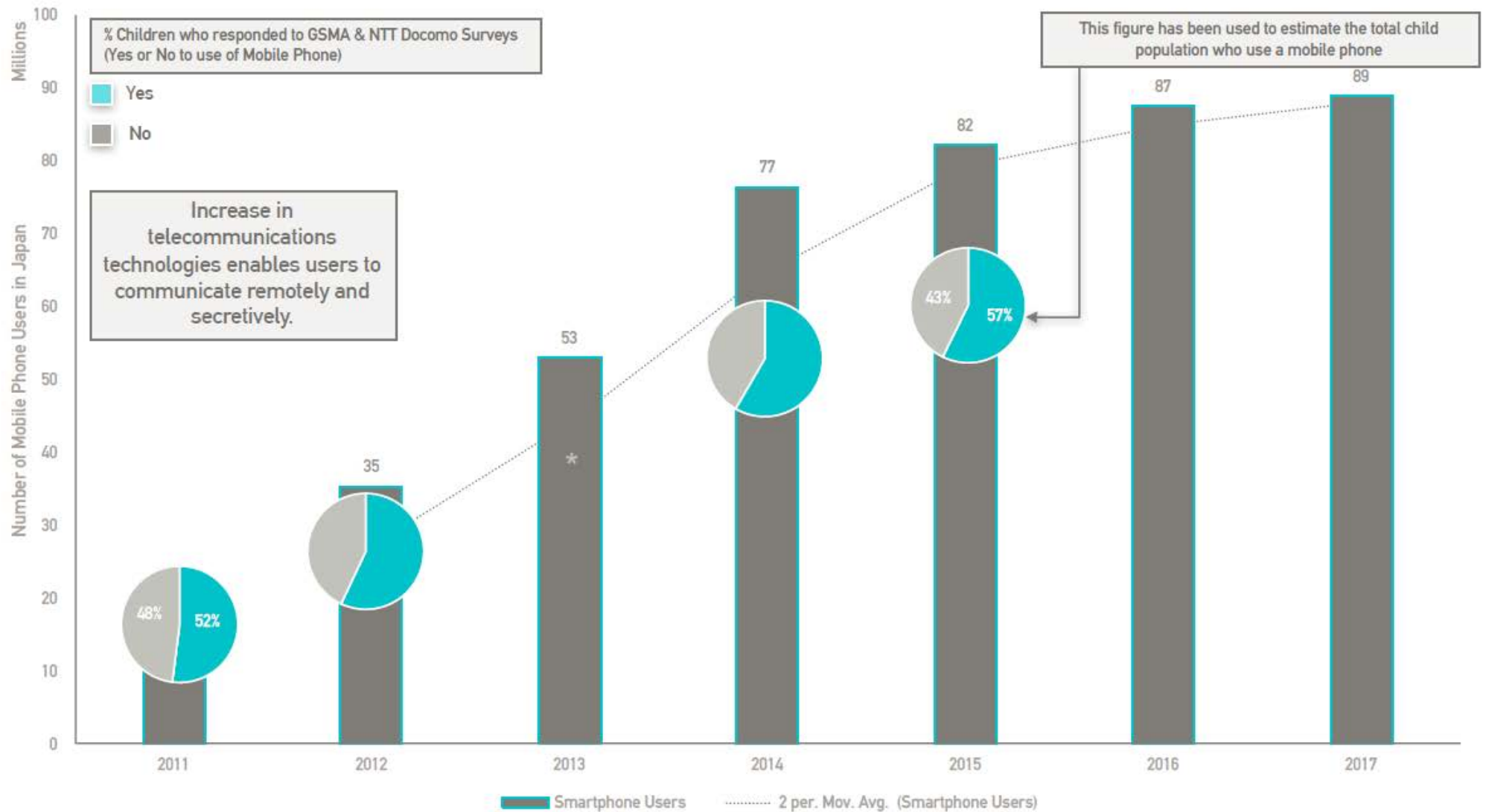
## RESPONSE

Application of the socio-economic costs to the class participants adjusting for a prevalence rate  
The social costs are calculated up to 2060 as a Net Present Value



# Driver

## Smartphone Use: Total Population with Child Use Overlay



\* Please note the 2013 GSMA survey did not include results for Japanese children

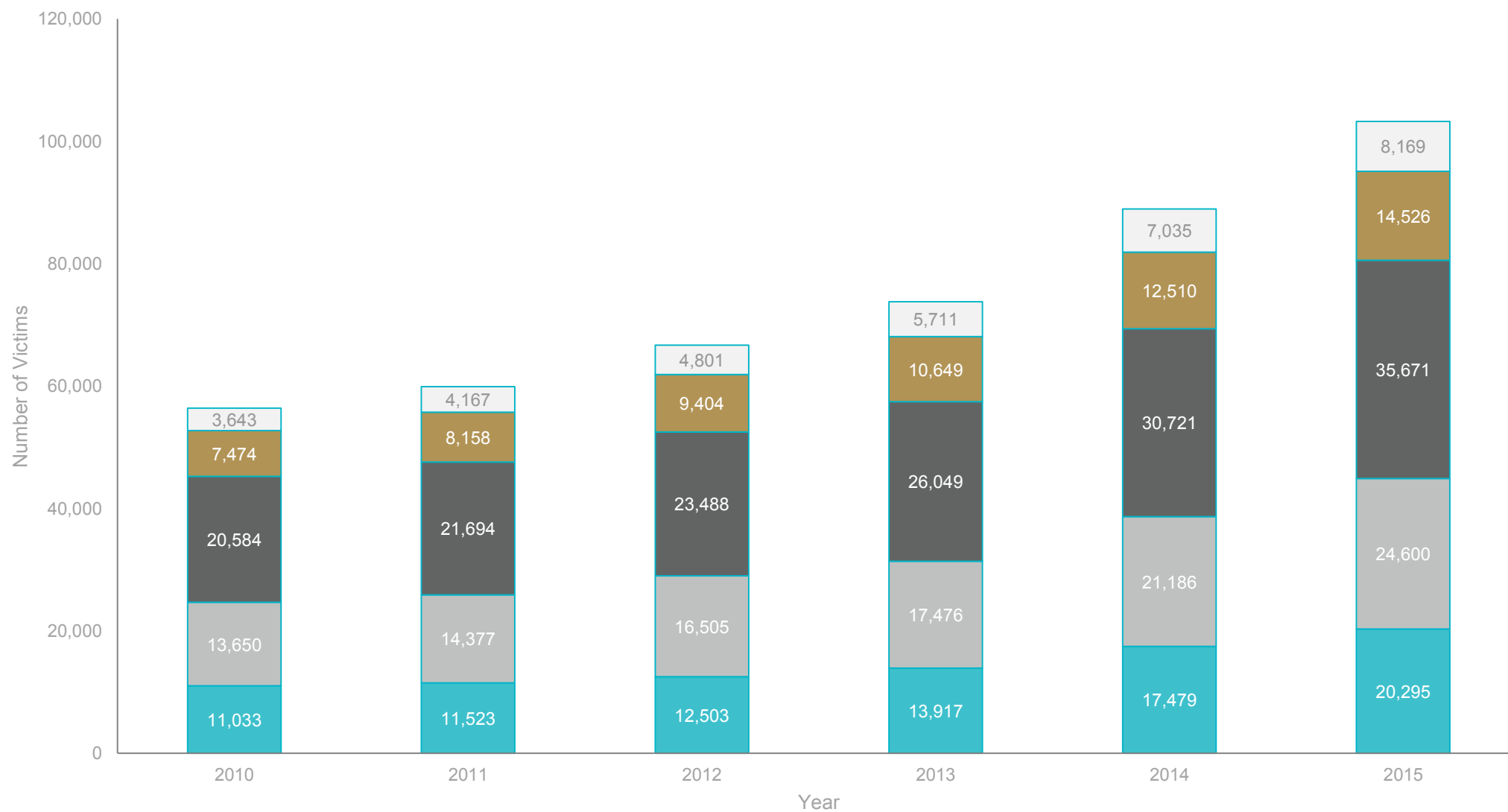
# Pressure

## Child Abuse

- The WHO defines child abuse as “all forms of physical and/or emotional ill-treatment, sexual abuse, neglect or negligent treatment or commercial or other exploitation, resulting in actual or potential harm to the child's health, survival, development or dignity in the context of a relationship of responsibility, trust or power.” (WHO 2016)
- According to the report on Social Welfare Administration and Services of Japan, Child Abuse is increasing year on year. In 2010 there were a total of 56,384 victims, in 2015 this had increased to 103,260. (Please see the chart on slide 8). (Japan Statistics 2017)
- Violations of special law cases concerning ‘The Act on Punishment of Activities Relating to Child Prostitution and Child Pornography, and the Protection of Children’ are also increasing. In 2012, there were 1,847 cases and in 2014 there were 1,967. Compared to other special law violation cases such as ‘The Gun-Powder Control Act’ or the ‘Toxic Substance and Violent Poison Control Act’ etc. which have on average decreased by 15% from 2013-2014, child prostitution and pornography cases are up 5%. (Japan Statistics 2017) (Please see the charts on slides 8 and 9)
- Specific to this analysis, it was reported in 2016 that “1,736 people under the age of 18 were targeted via mobile phones and Social Networking Services (SNS), exceeding the record set in 2015 by 84, and more than doubling the cases tallied in 2008 when police began keeping records” Of these victims, 84 were male and 1652 were female; 25% were victims of prostitution, 32% were victims of child pornography 38% were victims of molestation. Further, 1,509 victims used social networking services (SNS) on their mobile phone, 227 were non-smartphone users. (Japan Statistics 2017).
- Child Abuse, specifically sexual abuse is an increasing phenomenon in Japan. The rise in cases relating to pornography and SNS substantiate an implicitly known fear that the increase in information technologies specifically mobile phones and SNS give potential offenders greater opportunity to exploit children.
- The OECD and the United Nations have raised grave concerns over the risks facing the children of today who are using the internet at an ever greater rate and at an increasingly younger age. (OECD 2012)
- The UN suggests “potential offenders are able to gain enhanced access to victims and to child sexual abuse material through the use of ICTs, which increase their pool of potential victims, offer the opportunity to create false identities, and facilitate the transmission of harmful content to children”. (UNODC 2015).

# Pressure

## Child Abuse Cases by Age of Victim in Japan

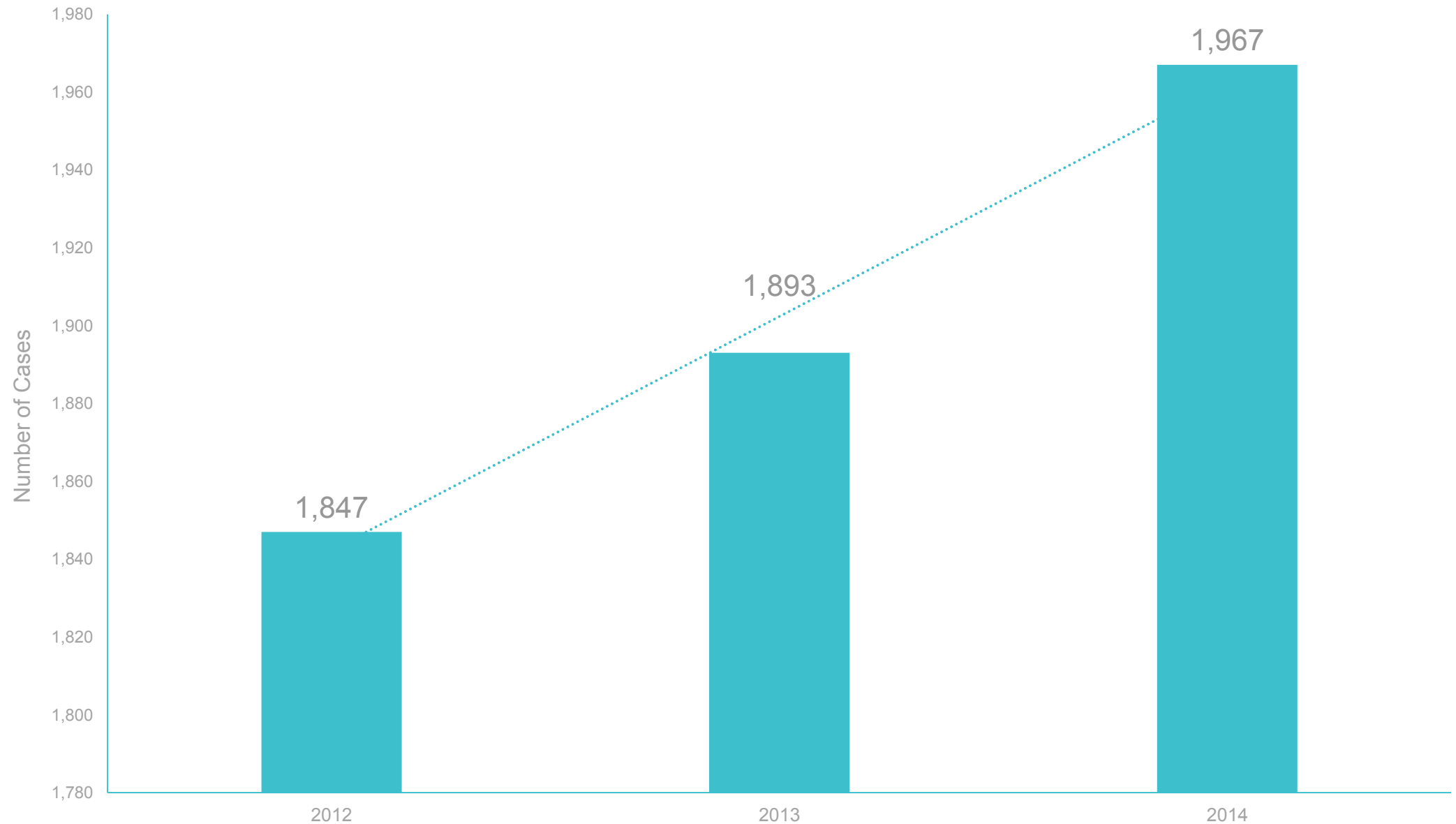


■ One year old, under ■ 3 years old to preschoolers ■ Elementary school students ■ Lower secondary school students ■ Upper secondary school students and others

# Pressure

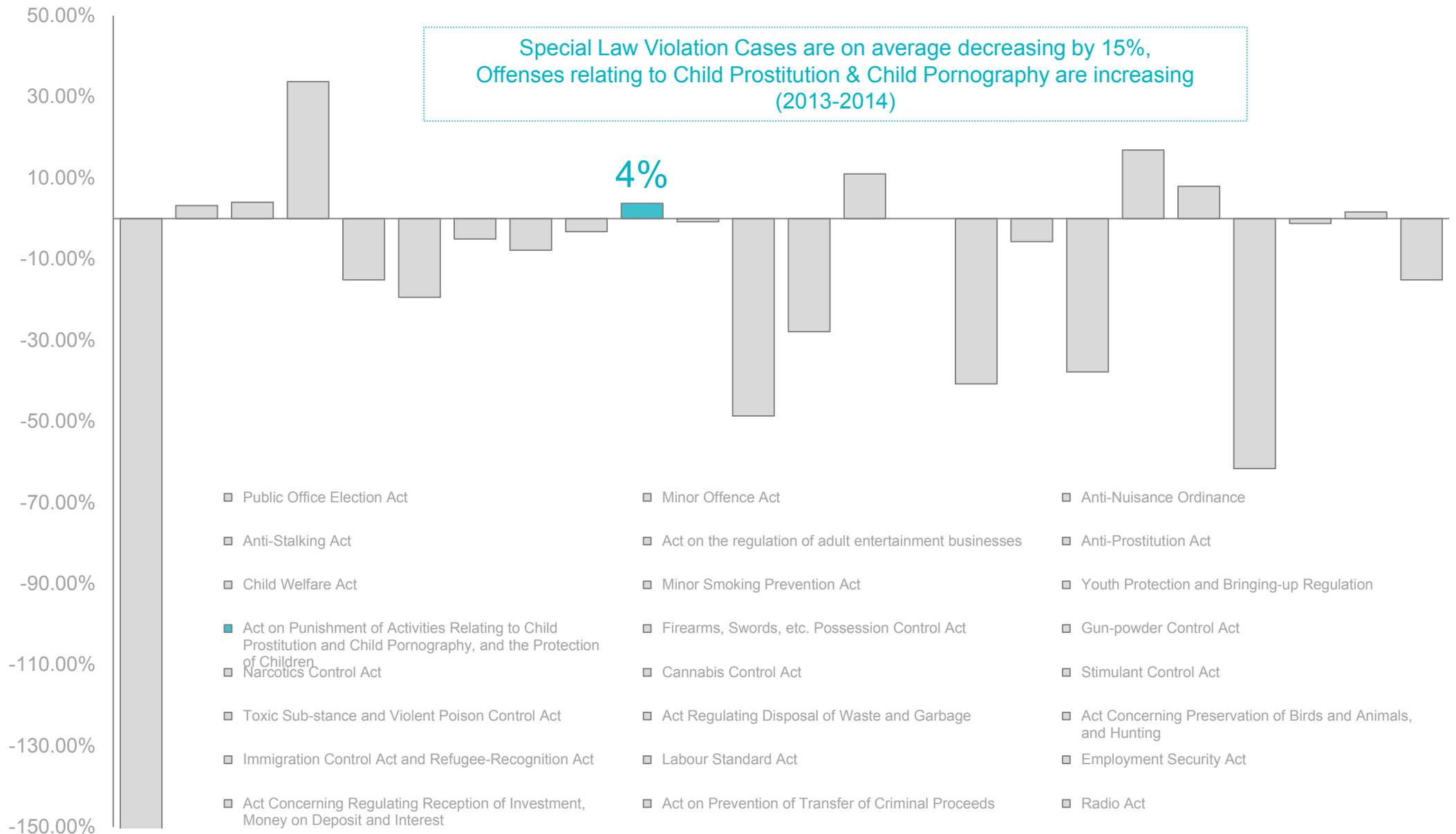
## Special Law Violation Cases:

Act on Punishment of Activities Relating to Child Prostitution and Child Pornography, and the Protection of Children.



# Pressure

## Special Law Violation Cases: 2013 – 2014 Percentage Difference in Cases



# State

## Child Abuse via Mobile Phones and SNS Services

“Potential offenders are able to gain enhanced access to victims and to child sexual abuse material through the use of ICTs, which increase their pool of potential victims, offer the opportunity to create false identities, and facilitate the transmission of harmful content to children” (UNDOC 2015)

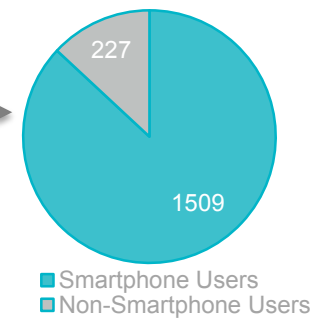
“In 2016 1,509 people under the age of 18 were targeted, via mobile phones and SNS exceeding the record set in 2015 by 84, and more than doubling the cases tallied in 2008 when police began keeping records.” (Japan Times 2016).

Prevalence is equal to the number of victims divided by the child population who use a mobile phone and SNS accounting for sex.

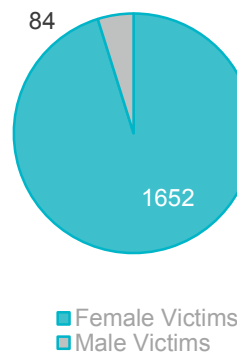
- Victims who use a smart phone = 1430 Females & 78 Males
- Male child pop. = 6,677,000
- Female child pop – 6,350,000
- % who use mobile = 57%
- % who of mobile users who use SNS on mobile = 87%
- At Risk male group = 3,290,292
- At Risk female group = 3,129,153

Prevalence – victims / at risk group  
Male prevalence = 2.3 per 100,000  
Female prevalence = 45.7 per 100,000

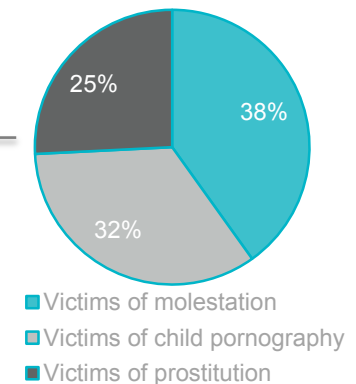
How the Victims Use Social Media



Gender Distribution of Victims



Victim by Child Abuse Type



# Impact

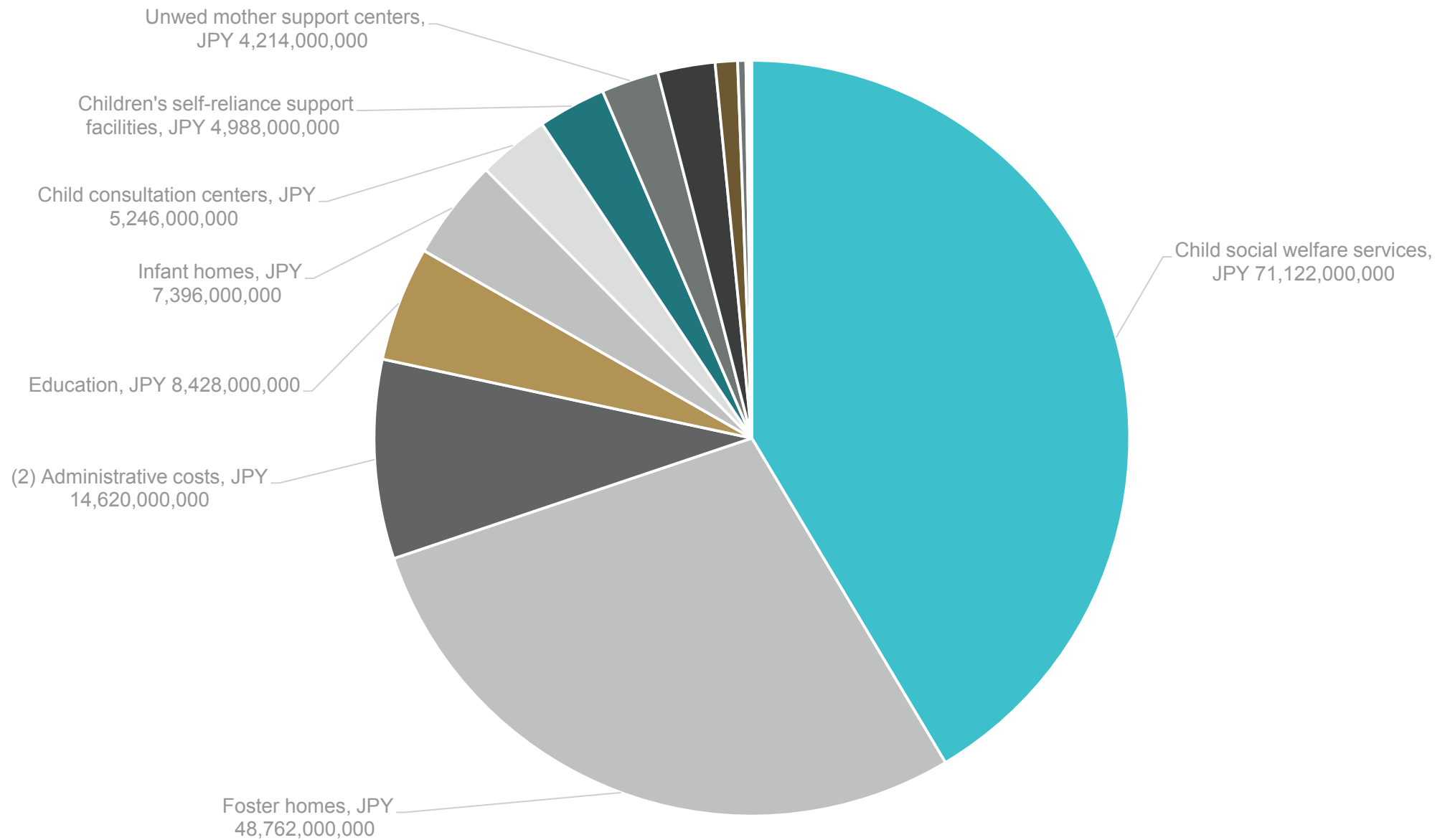
## Direct Costs

- The Direct costs used in this analysis are based on the research undertaken by Wada and Igarashi, 'The Social Costs of Child Abuse in Japan' (2014).
- Direct costs relate to: "1) Child social welfare services, 2) Administrative costs, 3) private group costs, and 4) research expenses"
- The authors note that "Japan suffers from the fatal flaw of having no database for medical expenses related to the effects of child abuse itself" – they were unable to estimate the medical expenses as direct costs in this present study. Therefore the direct costs in this analysis should be considered as an underestimate.

Direct costs.			
Item	People	Cost Per Person (JPY)	Total Cost (JPY, Millions)
Child social welfare services		-	71,122
Foster parents	4,295	378,400	1,634
Family homes	671	ND	0
Foster homes	29,399	1,659,800	48,762
Infant homes	3,000	2,459,600	7,396
Unwed mother support centers	3,714	1,135,200	4,214
Short-term therapeutic facilities for emotionally disturbed children	1,286	3,242,200	4,214
Children's self-reliance support facilities	1,525	3,242,200	4,988
Children's self-reliance aftercare facilities	390	ND	0
(2) Administrative costs		-	14,620
Child consultation centers	67,604	77,400	5,246
Local governments	73,200	8,600	602
Other costs		-	0
Police	No Data	No Data	86
Legal affairs	No Data	No Data	172
Education	No Data	No Data	8,428
(3) Private group costs	26	4,377,400	86
(4) Research expenses	95	1,272,800	86
Total direct costs		-	85,914

# Impact

## Direct Costs of Child Abuse





# Impact

## Indirect Costs Explained

The indirect costs outlined below relate to the table of indirect costs on page 16. The original calculations were made by Wada & Igarashi. Please note that these values will not necessarily reflect what is in the table as there are further calculations of prevalence for each of these factors to arrive at the final cost in the table. For example, the authors suggest that victims are 2.8 times more likely to commit suicide than non-victims they “use this value and the abuse prevalence rates by gender and age group to estimate the percentage of extra suicides caused by being abused as a child by gender and age group”. (Wada & Igarashi). This type of prevalence calculation is not outlined in this analysis because they are not necessary to estimate the final cost. This analysis will use a final risk ratio and total cost per victim by gender. **The key factor of indirect costs is that they are attributable to historic victims aged 20 and over reflecting the protracted nature of trauma.** All of the following text up to a conclusion explaining the costs is paraphrased from the authors publication.

### 1. Death Related Costs are productivity losses resulting from suicides.

- I. The authors show cumulative productivity losses (lost wages calculated from a wage census) related to suicide up to the age of 64 to be JPY 124,320,000 for males and JPY 86,030,000 for females

### 2. Medical Costs

The twelve month prevalence of depression reported by the authors is 1.17% in males and 3.06% in females.

The authors report a risk ratio of 3.6 for abuse victims.

The risk ratio is a measure of the increased likelihood of reaching an outcome due to an exposure

- I. Self harm: A risk ratio was used to estimate the **extra number of emergency transportation cases** multiplied by the cost per emergency of JPY 500,000.
- II. Mental Disorders (Medical expenses): **Medical expenses of mood disorders** (JPY 310.2 billion)
- III. Mental Disorders (Productivity Losses) **Productivity losses** of (JPY 2.1 trillion)
- IV. Other Medical Expenses: People who experience abuse have a significantly **higher amount of medical expenses** than non victims estimated at JPY 37,800.

### 3. Productivity losses

This is calculated through reduced lifetime earning resulting from poorer academic performance resulting from trauma onset by abuse.

# Impact

## Indirect Costs Explained

### 4. Divorce

There was no data available for the authors to calculate the increase in divorce for male victims however female divorces were calculated using a risk ratio and the associated social costs were **productivity losses**. (JPY 25.09 million)

### 5. Crime

Individuals who have been abused are more likely to commit crimes when they are older. The authors estimate an extra 9770 people are questioned for suspected crimes as a result of abuse. They then multiplied this figure by **judicial per person costs**. For example, JPY 11,571 for cases with no arrests.

### 6. Public Assistance

- I. Payment Increase: 2.091 million people receive **public assistance** in Japan of which 21.1% of the males have experienced abuse, and 25.0% of females have experienced abuse. Each of these individuals receives JPY 1.7 million.
- II. Support Reduction: Calculated as an '**opportunity cost of abuse**' where people who have abused their children receive less support (JPY 18,571) than those who have not.

### Conclusion:

- The authors present a comprehensive range of indirect costs that reflect the medical understanding of the long term traumatic effects of child abuse from a socio-economic perspective. The authors calculate the overall prevalence rate of historic child abuse victims to be 976,000 males and 2,789,000 female between the ages of 20-69. Not all of these victims will experience the factors outlined above, so when we take to total indirect costs per gender per person it is understood that this figure represents the cost distributed amongst the entire demographic thus accounting for the prevalence.
- From the year 2012 this demographic of historic victims have a distributed social cost of **JPY 289,501 per male historic victim per year, and JPY 344,869 per female historic victim per year**. (USD has been converted to JPY at a rate of 86.86 from the exchange rate dated 31/12/2016).
- These distributed costs are assumed to be constant per person for the year of this analysis (2016/2017).
- The **indirect costs reported in the study are attributable to adults (over 20 years old)** therefore these costs must be attributed on a time series.

# Impact

## Indirect Costs of Child Abuse

Indirect costs (2012)			
Item	Males Cost (JPY, millions)	Females Cost, (JPY, millions)	Total Costs (JPY, millions)
(1) Death-related costs	44,634	31,992	76,626
<i>Suicide</i>	<i>41,366</i>	<i>28,810</i>	<i>70,176</i>
<i>Death because of abuse</i>	<i>3,268</i>	<i>3,182</i>	<i>6,450</i>
(2) Medical costs	72,326	426,302	498,714
<i>Self-harm</i>	<i>86</i>	<i>258</i>	<i>344</i>
<i>Mental disorders (medical expenses)</i>	<i>7,310</i>	<i>49,192</i>	<i>56,502</i>
<i>Mental disorders (productivity losses)</i>	<i>49,278</i>	<i>332,132</i>	<i>381,410</i>
<i>Other medical expenses</i>	<i>15,652</i>	<i>44,806</i>	<i>60,458</i>
(3) Productivity losses (education)	31,304	89,354	120,658
(4) Divorce	0	324,220	324,220
(5) Crime	2,236	774	3,096
(6) Public assistance	142,760	125,560	268,320
<i>Payment increase</i>	<i>142,502</i>	<i>125,560</i>	<i>267,976</i>
<i>Support reduction</i>	<i>172</i>	<i>86</i>	<i>258</i>
Total indirect costs	293,260	998,288	1,291,548

# Impact

## Assessment of the Socio-Economic Costs of Child Abuse

- The socio-economic costs of child abuse are substantial. In Japan it is estimated to cost the public services 1 billion USD in direct health care costs at the year of abuse and 15 billion USD in indirect costs for historic child abuse victims.
- To put these figures into context and assess them it is worth considering the prevailing academic research from other countries on the socio-economic costs of child abuse.
- The table below shows a range of costs from different studies.
- The links to all sources may be found in the bibliography

The Social Costs of Child Abuse: Examples from a Selection of Studies					
Cost Description	Unit of Measure	Value	Year	Country	Author
Childhood Healthcare Cost	USD per Victim	\$32,648	2008	United States	Fang, Brown, Florence & Mercy
Adult Health Care Cost	USD per Victim	\$10,530	2008	United States	Fang, Brown, Florence & Mercy
Productivity Losses	USD per Victim	\$144,360	2008	United States	Fang, Brown, Florence & Mercy
Criminal Justice Losses	USD per Victim	\$6,747	2008	United States	Fang, Brown, Florence & Mercy
Child Welfare Costs	USD per Victim	\$7,728	2008	United States	Fang, Brown, Florence & Mercy
Special Education Costs	USD per Victim	\$7,999	2008	United States	Fang, Brown, Florence & Mercy

These costs are highly comparable with the Japanese specific costs used in this study. For example, the US total social cost per capita in 2008 was \$ 408, in Japan in 2012 it was \$125. The difference can be explained by different per capita levels of child abuse, and different health care systems. The important aspect to note here is that the Japanese costs used in this study are not extraordinary and fit with the prevailing academic wisdom.

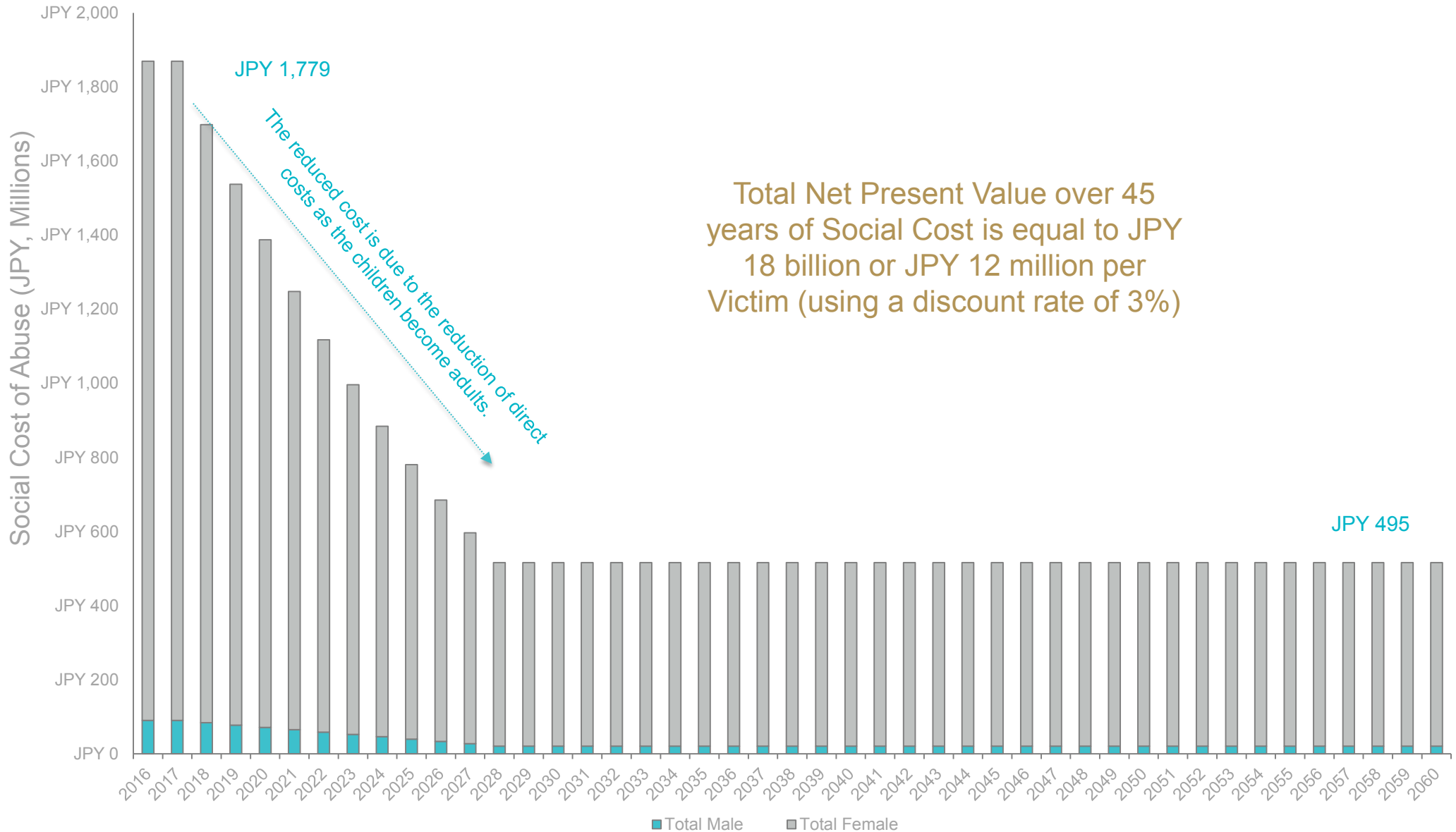
# Impact

## The Social Cost of Child Abuse

- Wada and Igarashi estimated the total social cost of child abuse in Japan in 2012 to be USD 16 billion (JPY 1.4 trillion, using the 2012 exchange rate of 86.6) based on 66,807 child abuse victims in 2012 and 2,789,000 adult female historic abuse victims and, 976,00 adult male historic child abuse victims.
- Assuming the same number of adult historic child abuse victims but 103,260 victims in 2015 (latest data) the current social cost of child abuse has increased to JPY 2 trillion (using an exchange rate of 120.31, 2015).
- This analysis draws focus to the use of SNS and mobile phones in the context of child abuse, of which there were 1,509 victims in 2016. The annual direct cost of these victims is estimated to be JPY 3 billion, (using an exchange rate of 116.5, 2016).
- Since the direct costs are related to childhood, and the indirect costs are related to adulthood as outlined in the description of the costs, annualized calculations have been made. It is assumed that there is an even distribution of abuse amongst ages (8-18) but the gender distribution is assumed to be 95% female (National Police Agency 2016). Indirect costs are attributed to the child when they turn 20 years of age (in accordance with Wada and Igarashi, 2014). Direct Costs are assumed to materialize annually up to the point of indirect costs.
- Adjusting for different ages, and gender and accounting for social costs up to the year 2060, the total Net Present Value of the social cost of child abuse relating to the 1,509 victims of 2016 is JPY 18 billion. This is a significant cost which accounts for all direct and indirect costs.

# Impact

## The Social Cost of Child Abuse: Victims of SNS and Mobile Phones



# Response

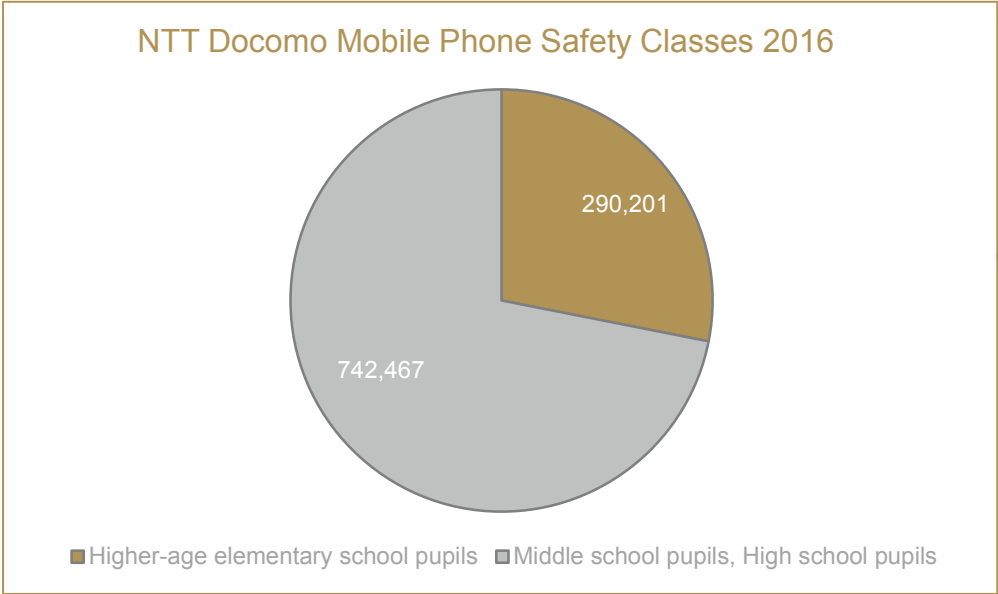
## NTT Docomo Mobile Phone Safety Classes

- 'Policy can mitigate but not eliminate the online risks faced by children' (OECD 2008)
- Legislative changes can create a deterrence through tougher judicial sentences for offenders. For example, in 2014 Japan banned the possession of child pornography. People found with explicit content can be imprisoned and fined up to 1 million yen.
- However, despite this change in 2014 "the number of children under 18 who have become victims of child pornography in Japan rose to a record-high of 383 in the first half of 2015, up 58 from the year before" (Japan Times, 2015).
- Clearly there is a role for the private sector to play whether it be through mandatory requirements of filtering explicit content, or through implemented educational programmes.
- NTT Docomo provides mobile phone safety classes to students, parents and seniors. In this example focus is drawn to the classes offered to Higher-Age Elementary School Pupils, and Middle School, and High School Pupils. In 2015 there were a total of 854,698 participants in these classes and 1,032,668 in 2016. Please see the table below for the full scope of the classes.
- NTT Docomo have therefore in 2016 successfully educated 1 million+ students on the risks they face online via their mobile phones in 2016.

			FY2015	FY2016
NTT Docomo's Cost (JPY)			JPY 634,114,726	JPY 682,206,490
Number of classes	Introductory version	Higher-age elementary school pupils	2,645	3,116
	Practical version	Middle school pupils, High school pupils	2,308	2,760
	Parent/Guardian version	Parents, Guardians	1,214	1,367
	Special needs version	Pupils at special needs schools, Workers at special needs facilities	322	340
	Senior version (Lecture-only course)	Seniors	84	85
	Senior version (Hands-on course)	Seniors	320	315
	<b>Total</b>		<b>6,893</b>	<b>7,983</b>
Number of participants	Introductory version	Higher-age elementary school pupils	233,990	290,201
	Practical version	Middle school pupils, High school pupils	620,708	742,467
	Parent/Guardian version	Parents, Guardians	172,715	210,198
	Special needs version	Pupils at special needs schools, Workers at special needs facilities	15,019	16,049
	Senior version (Lecture-only course)	Seniors	2,953	2,735
	Senior version (Hands-on course)	Seniors	5,423	5,762
	<b>Total</b>		<b>1,050,808</b>	<b>1,267,412</b>

# Response

## Estimation of Prevalence



The pie chart on the left shows the number of participants in two mobile phone safety classes. The 'Introductory Version' for 'Higher Age Elementary Pupils' and the 'Practical Version' for 'Middle and 'High School Pupils'. There was a total of **1,032,668** participants in these two classes in 2016

The prevalence rates are calculated by dividing the number of cases of child abuse via SNS and mobile phones by the estimated number of children who use a mobile phone. See page 22)

Prevalence Rates of Child Abuse via SNS and Mobile Phones 2016	
Total Prevalence	0.0202%
Male Prevalence	0.0024%
Female Prevalence	0.0457%

These prevalence rates are consistent with total child abuse vs child total population rates (0.00792%)



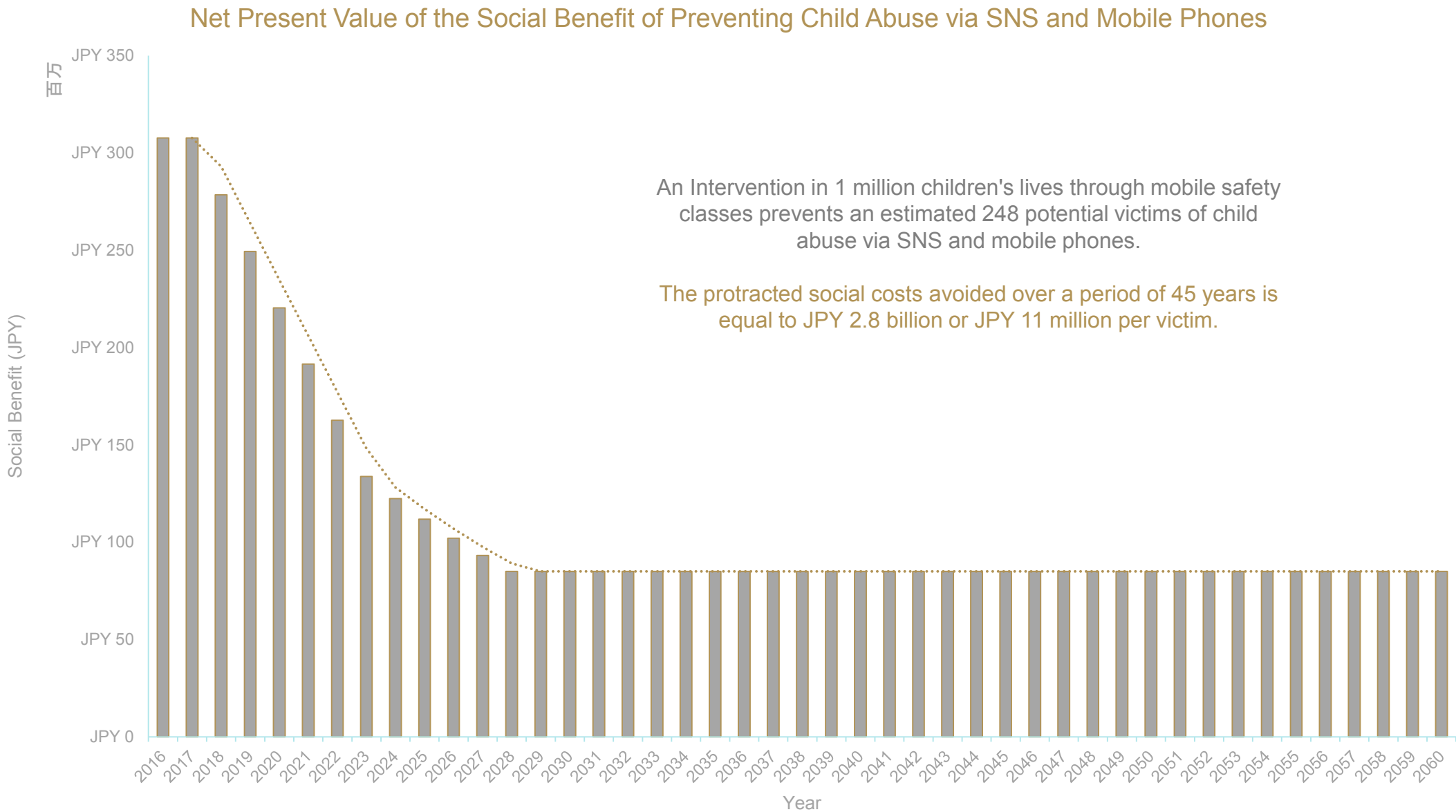
An estimated **248** out of the **1,032,668** participants of the class are statistically at risk of being victims of child abuse via SNS and Mobile phones.

It is assumed that there is an even number of children in each school year and an even gender distribution. The prevalence rates have been applied to each school year and gender to estimate the number of potential victims who were present in the NTT Docomo class.



# Response

## Social Benefit: The Avoided Social Cost of Child Abuse



# Summary

## Social benefits Of NTT Docomo's Mobile Phone Safety Class

- Child abuse has destructive and protracted impacts on those affected, therefore the evaluation of preventative measures (in terms of their social benefits) must recognise and analytically incorporate the temporal dimension.
- An early intervention, in this case a safety class, is a preventative measure educating children on the risks posed to them online via their use of mobile phones and SNS.
- Using prevalence rates, this analysis has estimated every **2 per 100,000 male, and 42 per 100,000 female child users of mobile phones and SNS to be at risk of child abuse.**
- This analysis concludes that NTT Docomo's early intervention is highly likely to have prevented the statistically at risk group of students from falling victim to potential offenders. The class is likely to have prevented a lifetime of trauma and the associated social costs.
- The NPV of the lifetime avoided social costs induced by abuse and trauma is equal to **JPY 2.8 Billion.** This avoided costs can be considered as an external benefit of NTT Docomo's classes and representative of one dimension of their **Value To Japanese Society.**

# Limitations of Study

1. The study has not included the children from the special needs class
  - In order to include this group further research is required to estimate the relative risk ratio of special needs children and child abuse, specifically that which is associated with mobile phones. Without concrete evidence of an increase or decrease risk ratio adjusted for disability type, including this group is problematic and unjustified
2. There is no estimate of the success of the classes
  - It could be argued that the classes are not 100% effective and therefore do not prevent all cases of child abuse
3. The child abuse cases via mobile phones are reported from 2015 and published in 2016
  - The analysis would be richer with a more current understanding of the levels of abuse.
4. The analysis has assumed an even gender and age distribution in the classes
5. The study could benefit from a greater understanding of the exact methods offenders use to victimize children via mobile phones

## 2. Societal Benefits Of Avoided Fraud Against the Elderly Through Mobile Phone Safety Class

**Driver-Pressure-State-Impact-Response**  
**Societal Benefits Of NTT Docomo's Select Services**

# Executive Summary

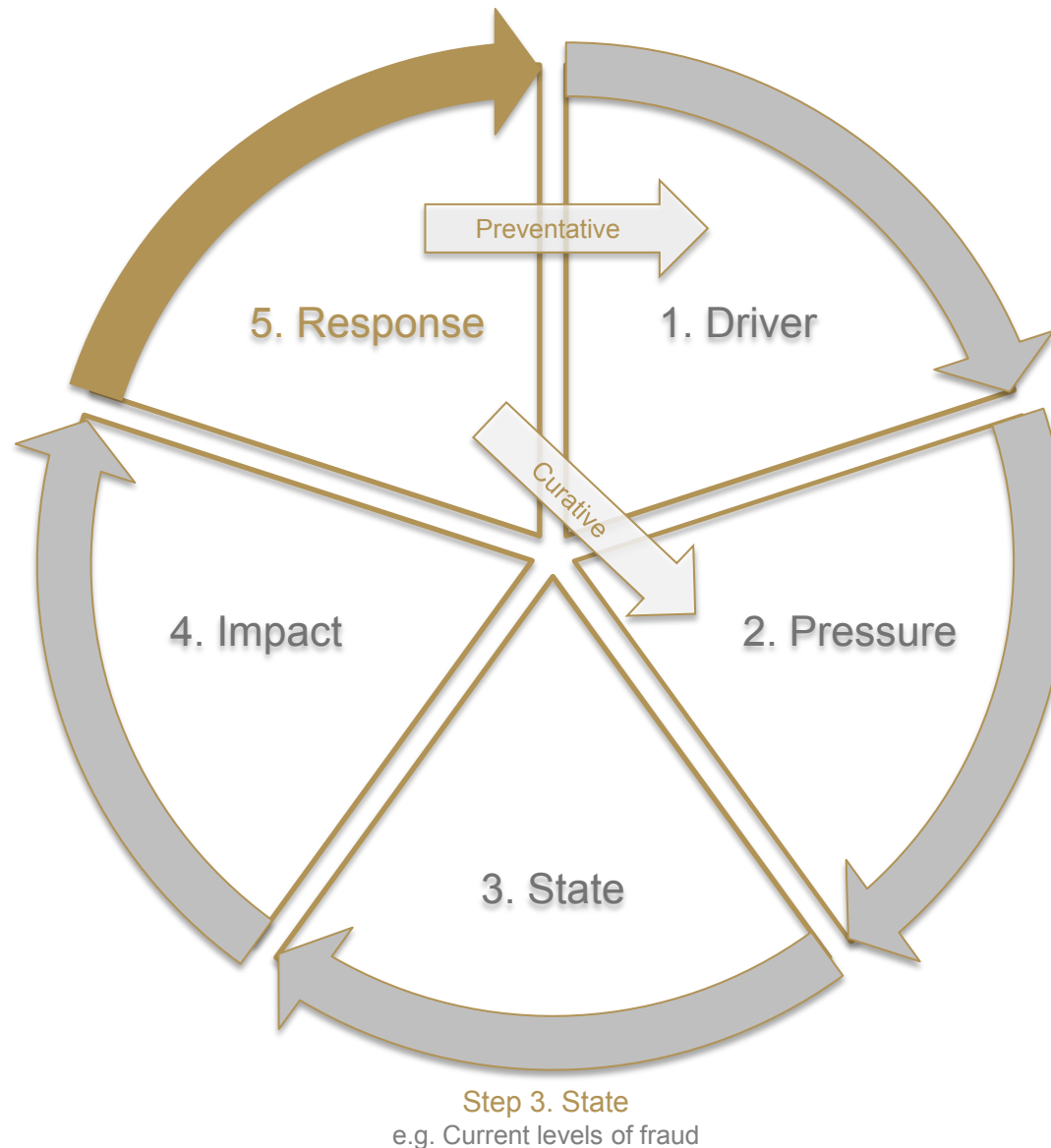
- Japan's ageing population are increasingly living alone in a rapidly evolving technological environment & faced with an ever-present increasing danger of fraud
- In 2015 there were [5,408] cases of special fraud that targeted the elderly, which cost Japanese society [JPY 19 billion].
- Preventative interventions that educate the potential victims on the risks and how to identify and mitigate fraud are morally and economically necessary.
- NTT Docomo's 'Mobile Phone Safety Classes' provide participants with the necessary knowledge to avoid such scams and, hence, the resulting avoided societal costs can be attributable to NTT Docomo and further conceived as one dimension of NTT Docomo's Value To Japanese Society
- In 2016 there were [8,487] senior participants in the class. Of this group it is estimated that [3.12] participants would have been a victim of fraud had they not attended the class.
- The social benefit of preventing fraud in these cases amounts to [JPY 11.2 million]
- The following slides will detail how this conclusion was reached

# Product Social Benefit Assessment and Evaluation

## Driver-Pressure-State-Impact-Response [DPSIR]

**Step 5: Response**  
e.g. Mobile phone safety classes prevent participants from being exploited by educating them on the prevailing risks and ways to mitigate them

**Step 4: Impact**  
e.g. The socio-economic impacts of fraud



**Step 1: Driver**  
e.g. Increase in mobile phone use amongst ageing population who increasingly live alone

**Step 2: Pressure**  
e.g. Increasing levels of fraud targeting the elderly

**Step 3: State**  
e.g. Current levels of fraud

- the DPSIR approach is non-linear, reflecting the cyclical nature of socio-economic impacts and their respective drivers -

# Flow of Analysis

## DRIVER

Evidence of the increasing use of mobile phones amongst by Japan's senior citizens  
Further, evidence is provided on the existence of an ageing population who are increasingly living alone

## PRESSURE

Evidence of the increasing number of cases of fraud

## STATE

Evidence of the current reported figures of special fraud cases targeting the elderly

## IMPACT

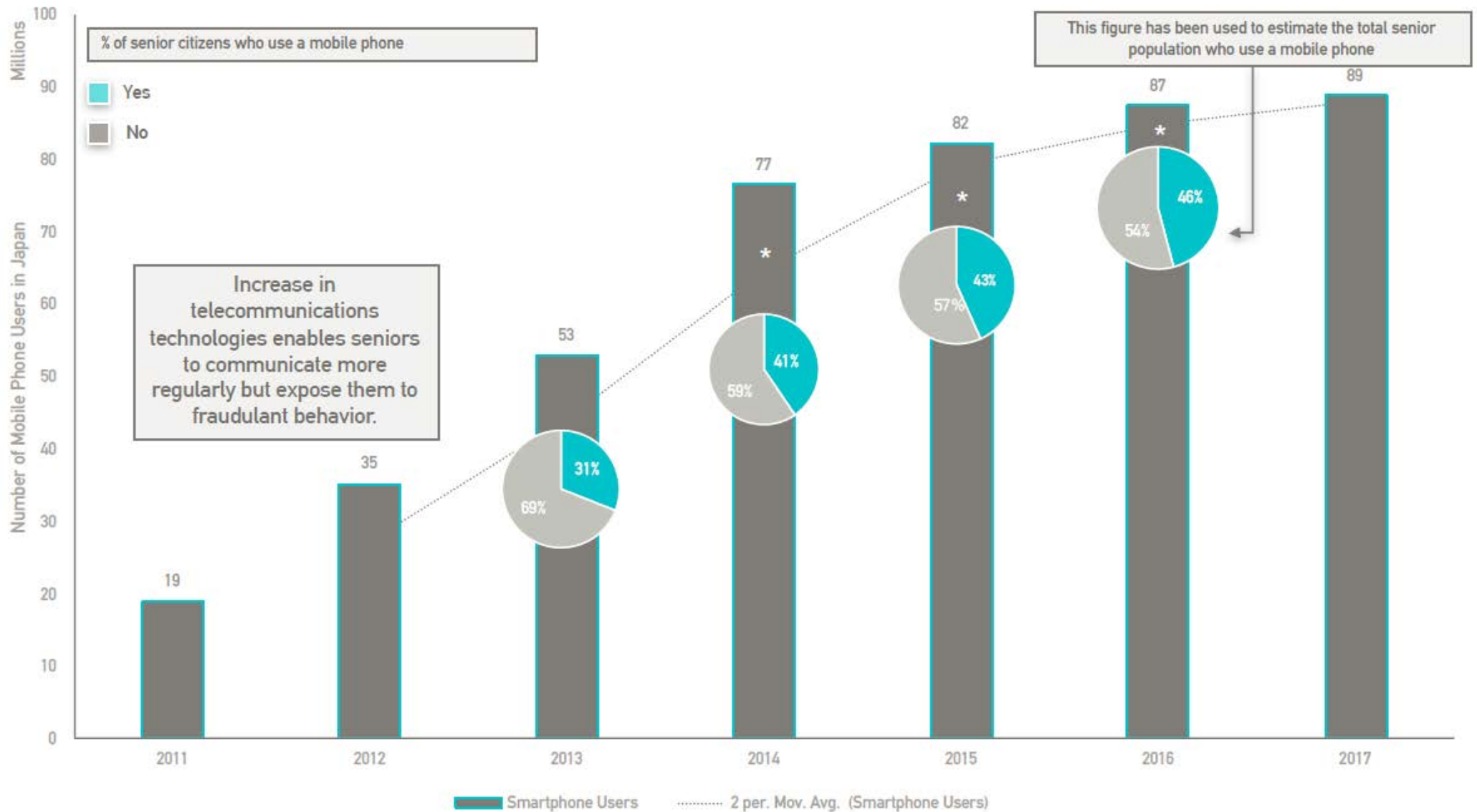
Evidence of the socio-economic impact of fraud. This includes the amount defrauded and the judicial and police costs associated with the crime itself

## RESPONSE

Application of the socio-economic costs to the class participants adjusting for a prevalence rate

# Driver

## Smartphone Use: Total Population With Senior Use Overlay



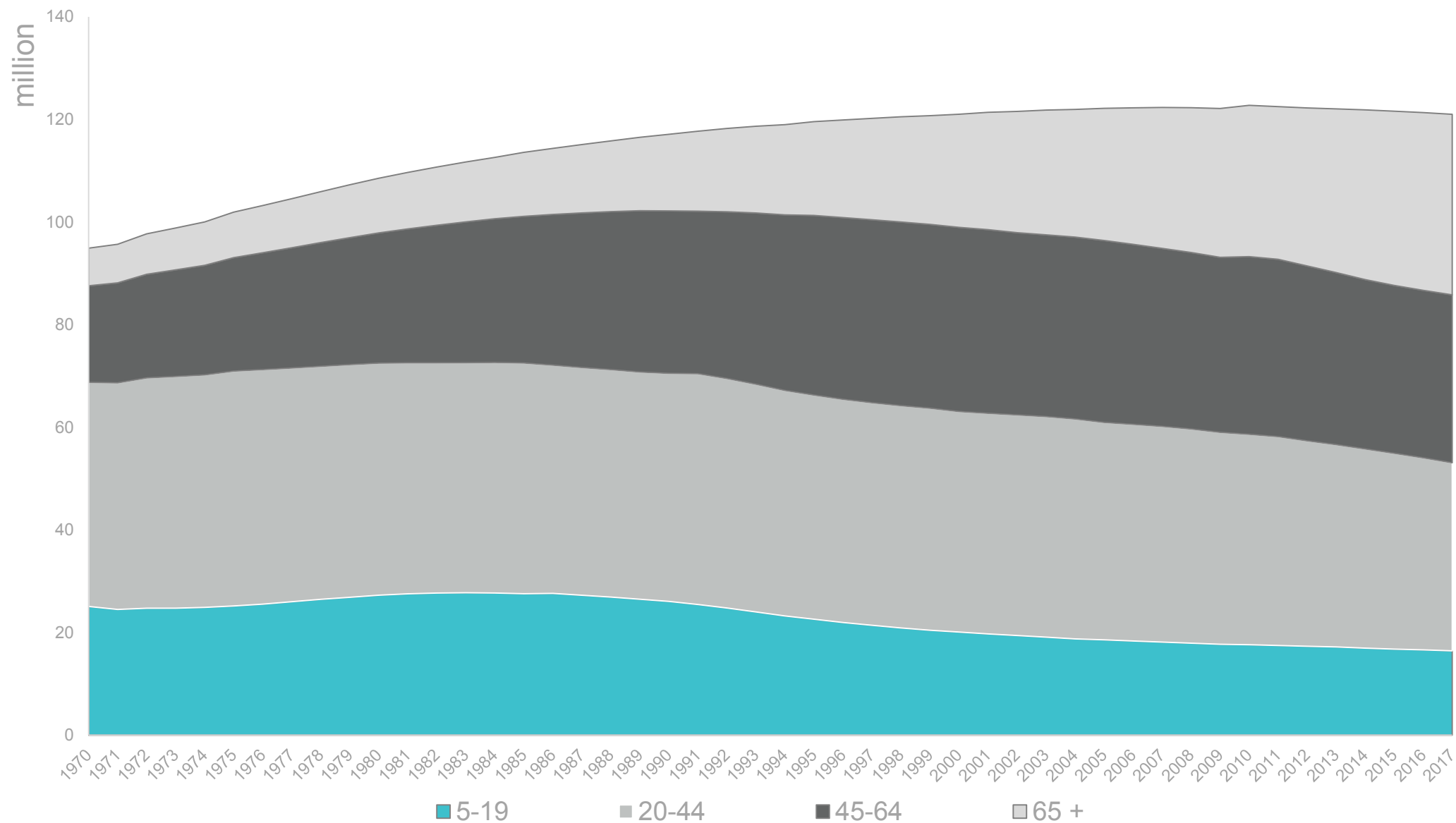
\* Please note the years 2014-2016 are estimates based on a proportional increase according to the total mobile use trend

Year



# Driver

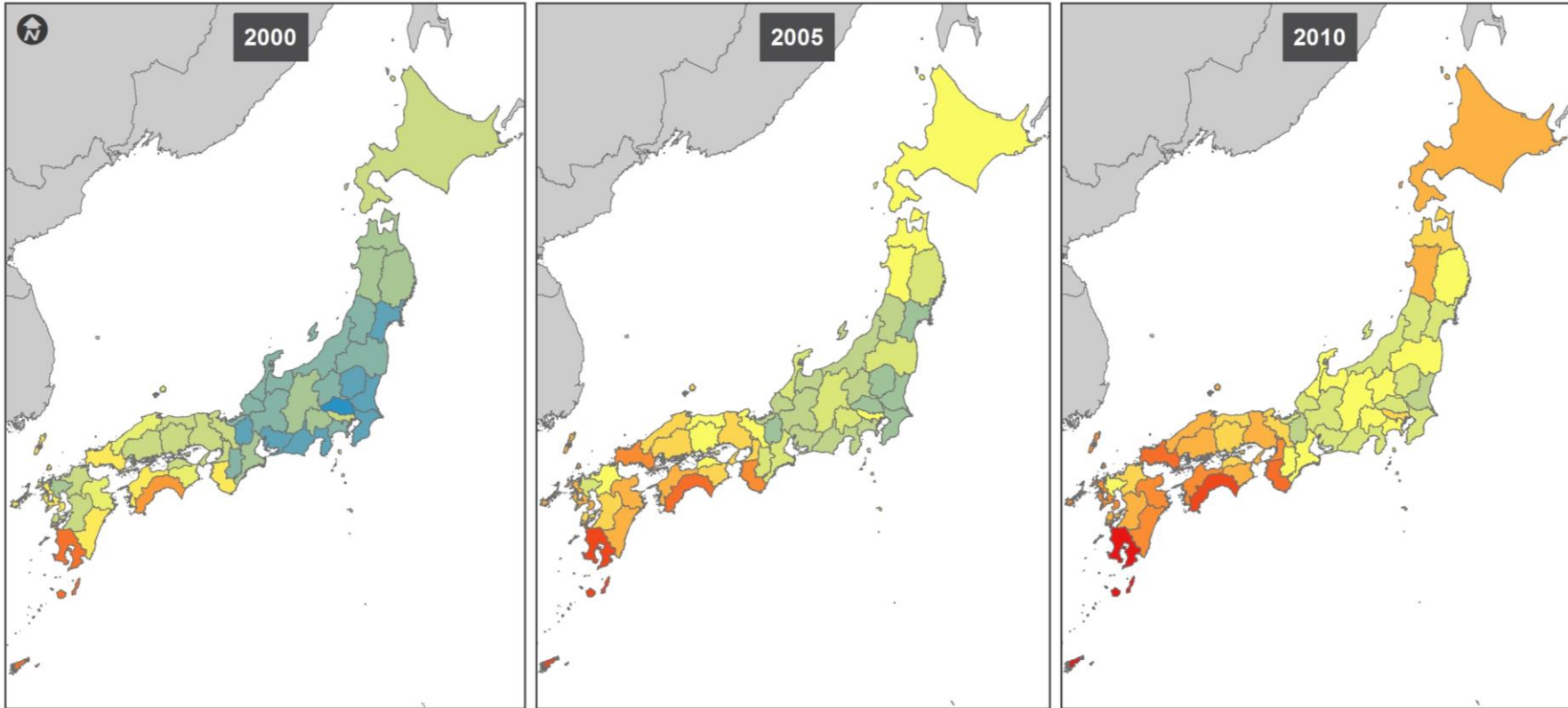
## Ageing Population



# Driver

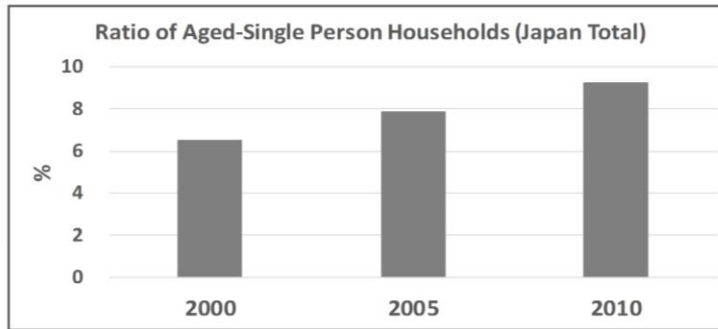
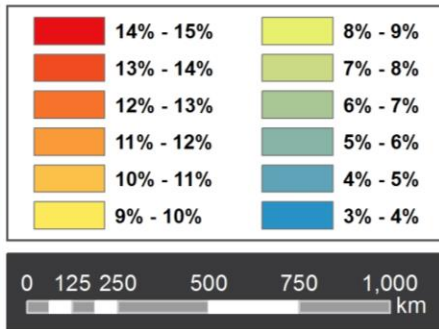
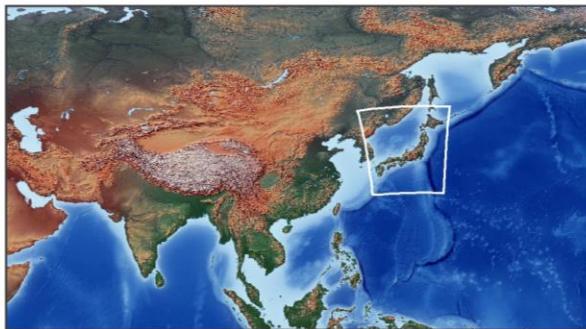
## Single Person Ageing Households

### 高齢単身世帯の割合



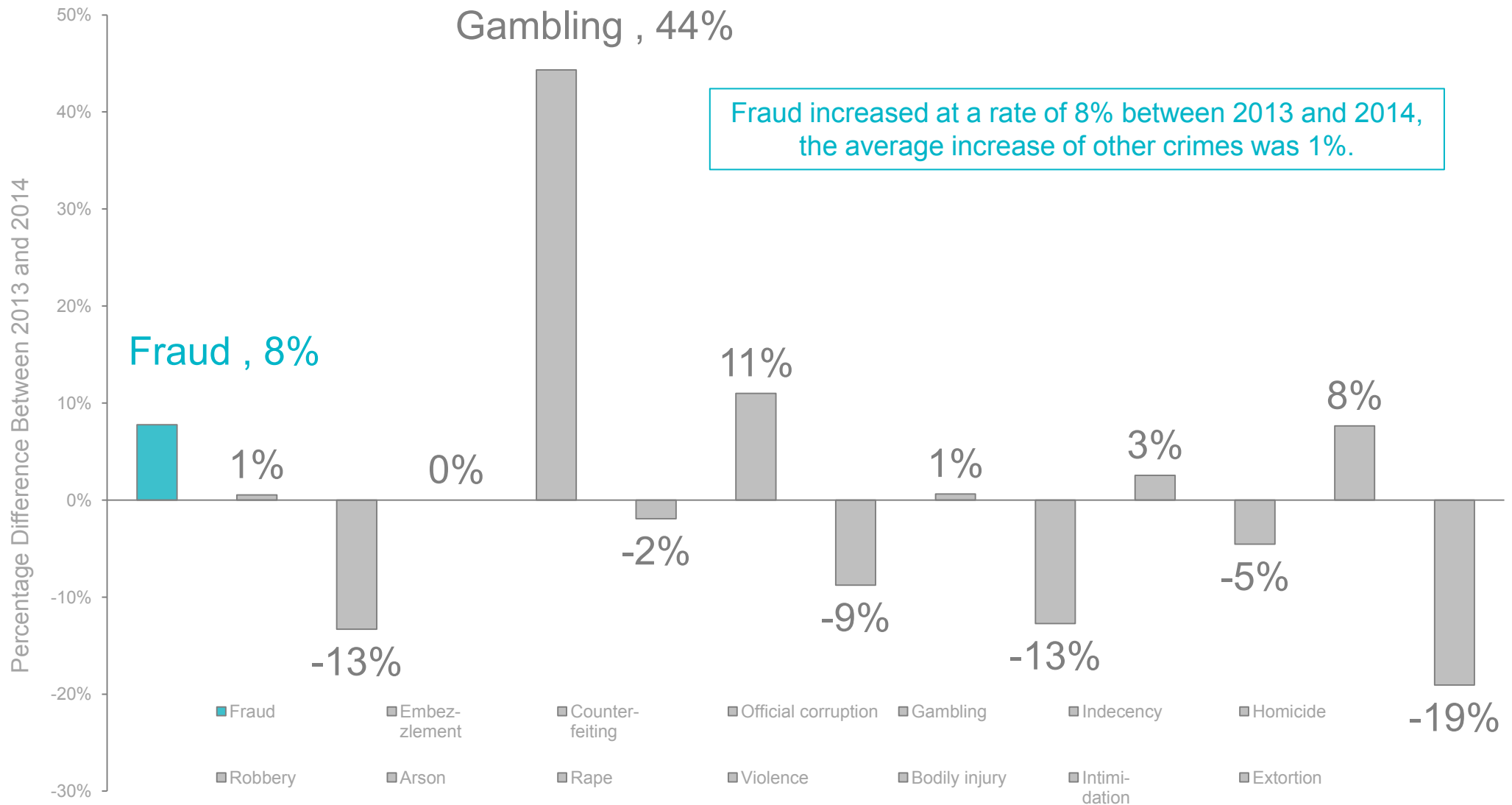
Okinawa has the highest ratio of [14.1%], Kyoto Fu has the lowest of [6.55%]

These maps demonstrate an increasing trend of senior citizens living alone. It is not just an ageing population that drives an increase in fraudulent behavior targeting the elderly. Loneliness and solitude increase vulnerability as there is no social support that could intervene at the point of fraud.



# Pressure

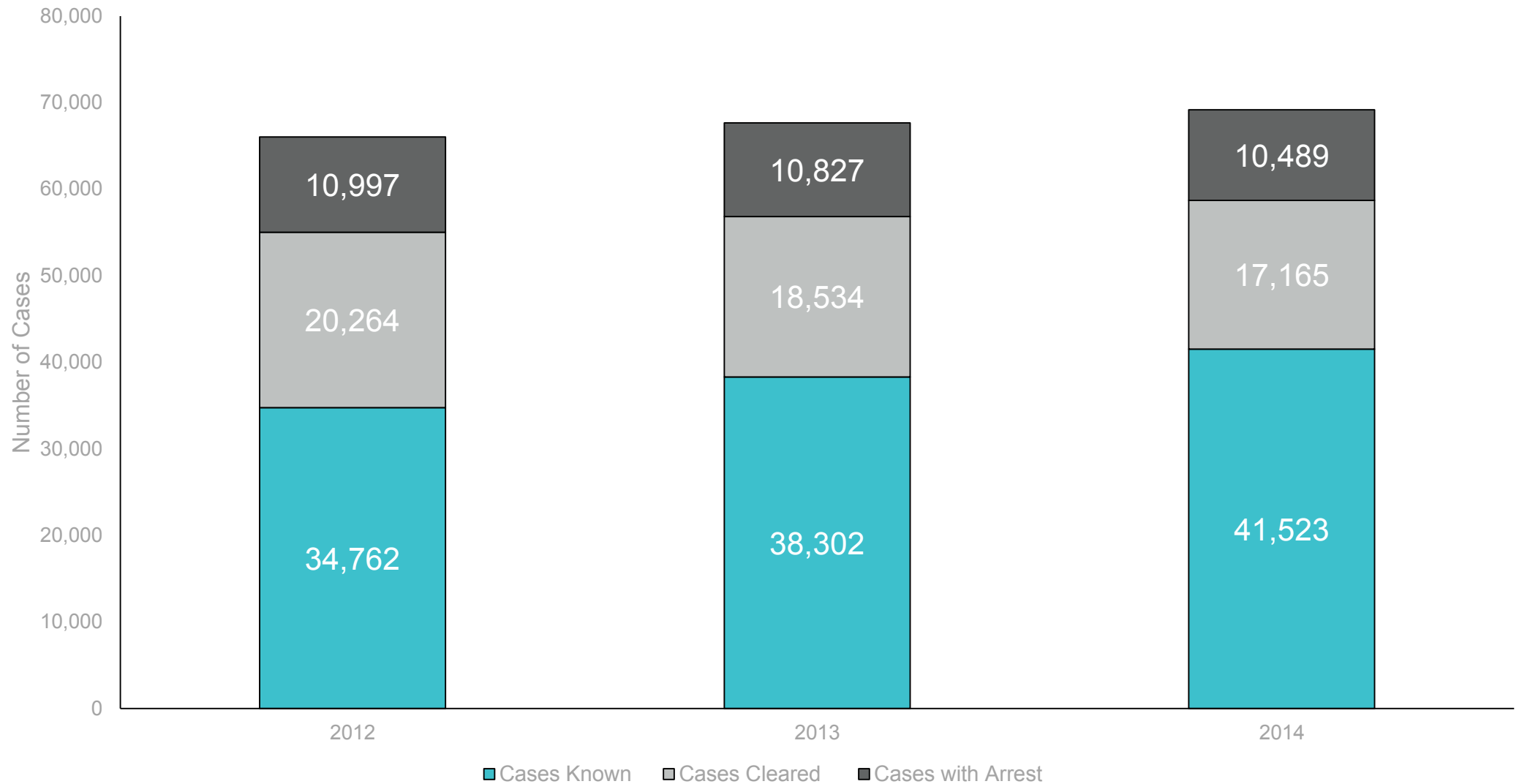
## Crime Cases Known to the Police: Percentage Difference Between 2013 and 2014



# Pressure

## Fraud: Status of Cases

The chart below show the status of general fraud cases as published by the National Police Agency.  
The status of the case is important in terms of costs as will be shown in the impact section of this analysis. (Japan Statistics, 2017)

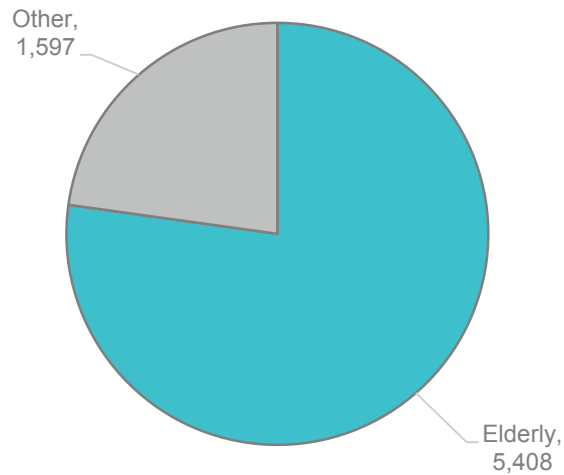


# State

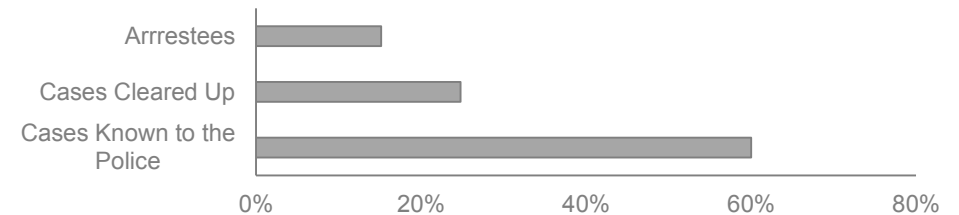
## Special Fraud Cases

Elderly people account for [77.2] percent of the [5,408] confirmed special fraud cases (Japan Times, 2015).

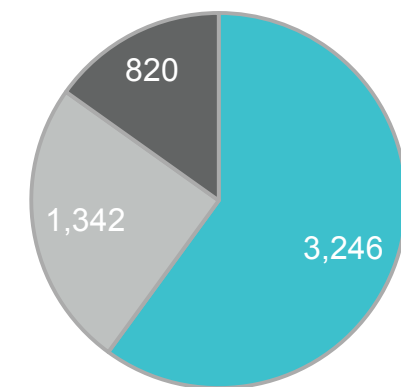
Number Of Special Fraud Cases (2015)



Estimated Result of Case



Elderly Cases



■ Cases Known to the Police ■ Cases Cleared Up ■ Arrestees

43% of Elderly Population [14,712,315] use a mobile phone

These Proportions will be used in the impact assessment

Prevalence of elderly special fraud is equal to the number of cases / elderly population who use a mobile phone.

36.76 per 100,000 Elderly Mobile Phone Users

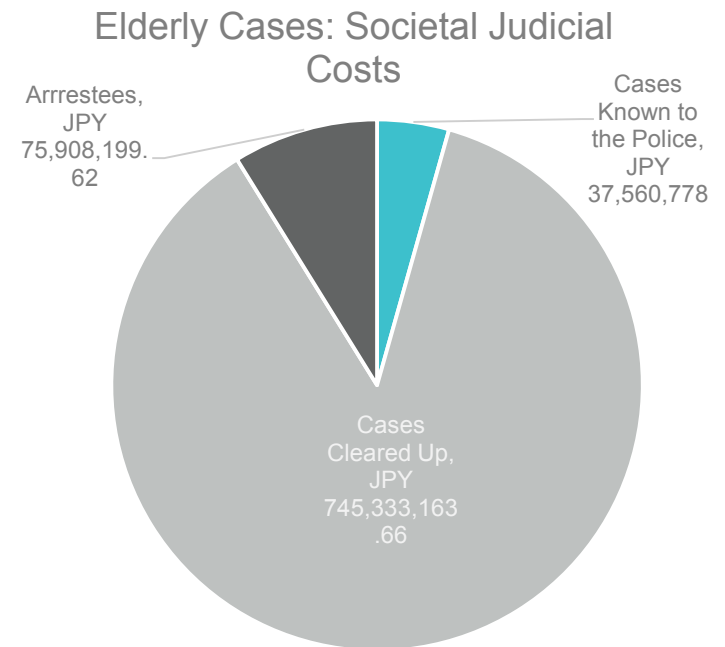
# Impact

## Socio-Economic Impact of Fraud

- The National Police Agency [NPA] estimate the cost of special fraud cases, including those which targeted the elderly, equaled a total of JPY [23.65] billion in 2015.
- Elderly fraud is estimated to cost JPY [18.3] billion
- This equates to an average of JPY [3.4] million per case
  - 5,408 cases
- There are additional societal costs associated with crime. For example Wada & Igarashi (2014) cite a study by Ikegami (2003) (Japanese only) that considers the cost of crime where the variables are:
  1. Cases with no arrest or detention
  2. Cases with an arrest but no detention
  3. Cases with an arrest and detention
  - See table below for the costs.

Judicial Costs of Crime	
Judicial cost for cases with no arrest or detention	JPY 11,571
Cases with an arrest but no detention	JPY 92,572
Cases with an arrest and detention	JPY 555,433

- Cases described by the NPA as 'cleared' are assumed to be those that result in an arrest and detention (because detention implies a judicial process where the individual has been found guilty in a court of law). Cases described by the NPA as 'arrestees' are assumed to be cases with an arrest but no detention. Finally, 'known' cases are assumed to be cases for which there is no arrest or detention.
- These assumptions permit a societal judicial cost of elderly fraud to be made. Using the latest year of distribution of case type on page 10, the same proportions were applied to the total number of elderly special fraud cases. Then the judicial costs of crime were applied. The results can be seen in the pie chart to the right
- The total cost including the amount defrauded and the judicial costs equates to JPY [19.1] billion. This assumes 87% of the cases to be 'cleared', 9% to have just lead to an 'arrest' and 4% to be just 'known'. The judicial costs account for JPY [850] million, and the defrauded amount is JPY [18.3] billion.



# Response

## NTT Docomo Mobile Phone Safety Class for Seniors

- In 2016 NTT Docomo provided 400 mobile phone safety classes for a total of 8,497 senior citizens
  - The classes educate senior citizens on the how to detect and avoid fraudulent activity
- It is likely that most of the seniors of the class would have not been a victim of fraud in their lifetime, however using the previously calculated prevalence rate it is estimated that [3.12] out of the [8,497] participants were likely to be victims of fraud.
- The potential cost scenario's of one case are outlined below.

SCENARIO 1 (CASE CLEARED)	SCENARIO 2 (CASE WITH ARREST)	SCENARIO 3 (CASE KNOWN)
Judicial Costs JPY 555,433	Judicial Costs JPY 92,572	Judicial Costs JPY 11,571
+	+	+
Defrauded Amount JPY 3,376,072	Defrauded Amount JPY 3,376,072	Defrauded Amount JPY 3,376,072
=	=	=
JPY 3,931,505	JPY 3,468,644	JPY 3,387,643

# Summary

## Social benefits Of NTT Docomo's Mobile Phone Safety Class

- Japan's population continues to age, it would also appear that the number of senior citizens living alone will also increase
- Mobile telecommunications are necessary and can help mitigate feelings of loneliness and depression. However as this analysis has shown, the increase in mobile phone use amongst the elderly opens further channels to exploit this vulnerable demographic.
- NTT Docomo provides classes that educate senior citizens on the risks of mobile phone use related to fraud.
- For every case of fraud that is prevented a social benefit of between JPY 3.4 million and JPY 3.9 million can be expected.
- Of the 8,487 participants of the class it is estimated that 3.12 were statistically at risk of becoming a victim of fraud.
- Using the average cost of the 3 scenarios, this analysis concludes NTT Docomo produced an external societal benefit of JPY 11,2 million by preventing the members of one of Japan's most vulnerable communities from being defrauded.
- For every prevention of fraud case an average social benefit of JPY 3,595,931 can be attributable to the services of NTT Docomo.



# Limitations of Study

## 1. The study lacks substantial depth

- This study only considers the defrauded amount and judicial costs of fraud, there are further socio economic impacts that could be assessed such as depression resulting from fraud. Further, positive impacts of mobile phone use could be quantified and valued, such as increased capacity to communicate with family members.

## 2. There is no estimate of the success of the classes

- It could be argued that the classes are not 100% effective and therefore do not prevent all cases of fraud

### 3. Societal Benefits Of Preventing Children from Overuse of their Mobile Phones

**Driver-Pressure-State-Impact-Response**  
**Societal Benefits Of NTT Docomo's Select Services**

# Executive Summary

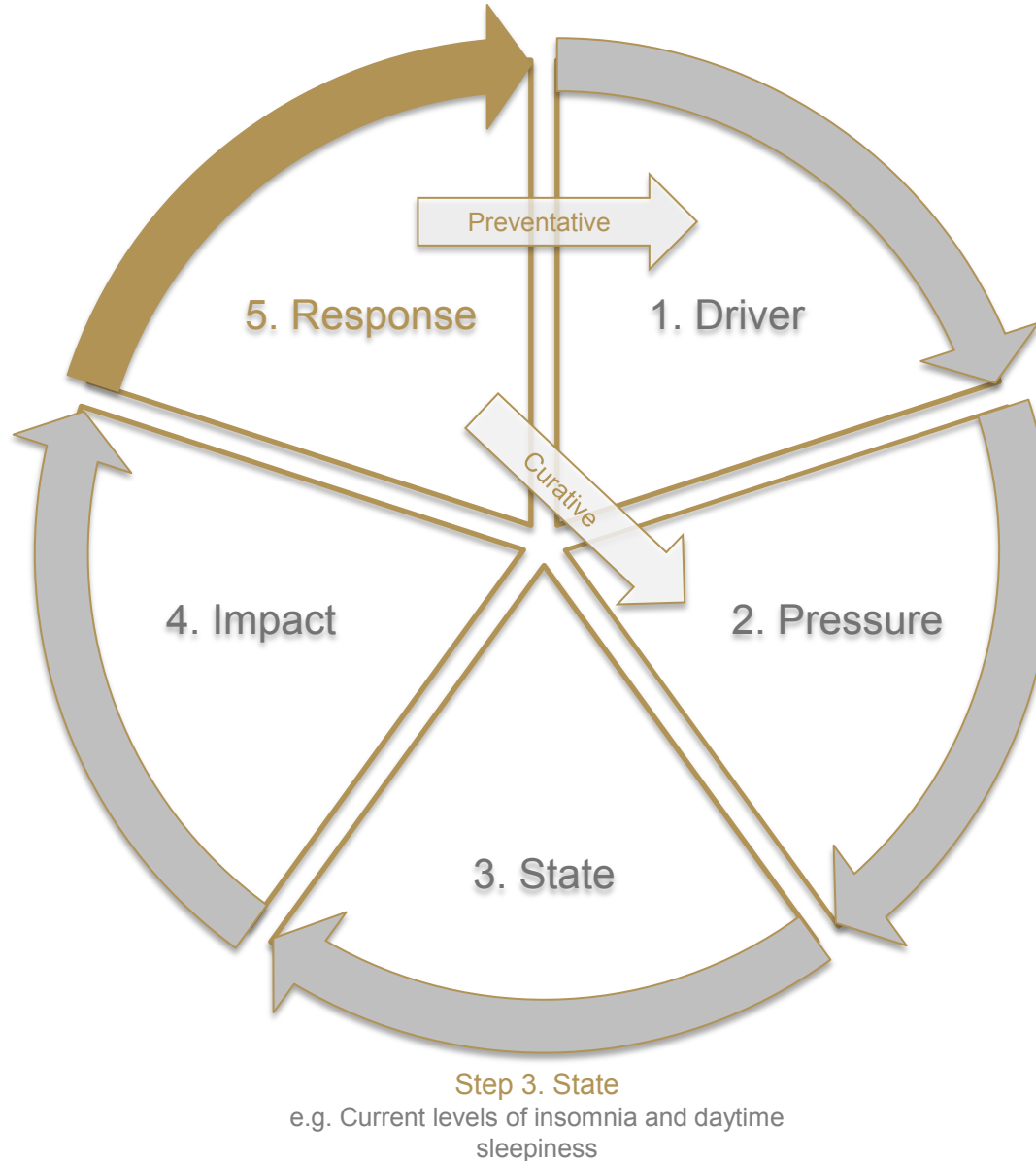
- Insomnia and Daytime Sleepiness are markedly common amongst adolescents in Japan.
- A key factor is the prevalence of mobile phone over-use, particularly at night.
- This analysis finds that NTT Docomo's provision of Mobile Phone Safety Classes has prevented [64,027] adolescents from experiencing insomnia, through education on optimal use of mobile phones.
- This prevention of insomnia has a societal benefit equal to [JPY 1.3 billion], in terms of avoided healthcare costs, and is representative of one dimension of NTT's Docomo's Value To Japanese Society
- The class is also expected to improve exam grades of [64,027] students by up to [10] per cent. Evidence suggests, such improvement can have significant positive economic impact in terms of GDP growth (once the students enter into employment).

# Overview

## Driver-Pressure-State-Impact-Response [DPSIR]

**Step 5: Response**  
e.g. Mobile phone safety classes that teach children the detriments of mobile phone over-use. The solution is preventative

**Step 4: Impact**  
e.g. The healthcare costs associated with treating the effects of insomnia and lost economic growth through unrealised educational attainment



- the DPSIR approach is non-linear, reflecting the cyclical nature of socio-economic impacts and their respective drivers -

# Flow of Analysis

## DRIVER

Evidence of increased availability and over-use of mobile phones amongst and by Japanese adolescents.

## PRESSURE

Evidence of increasing proportion of Japanese adolescents suffering poor sleep quality and daytime sleepiness

## STATE

The current levels of mobile phone penetration, insomnia and daytime sleepiness amongst Japanese adolescents

## IMPACT

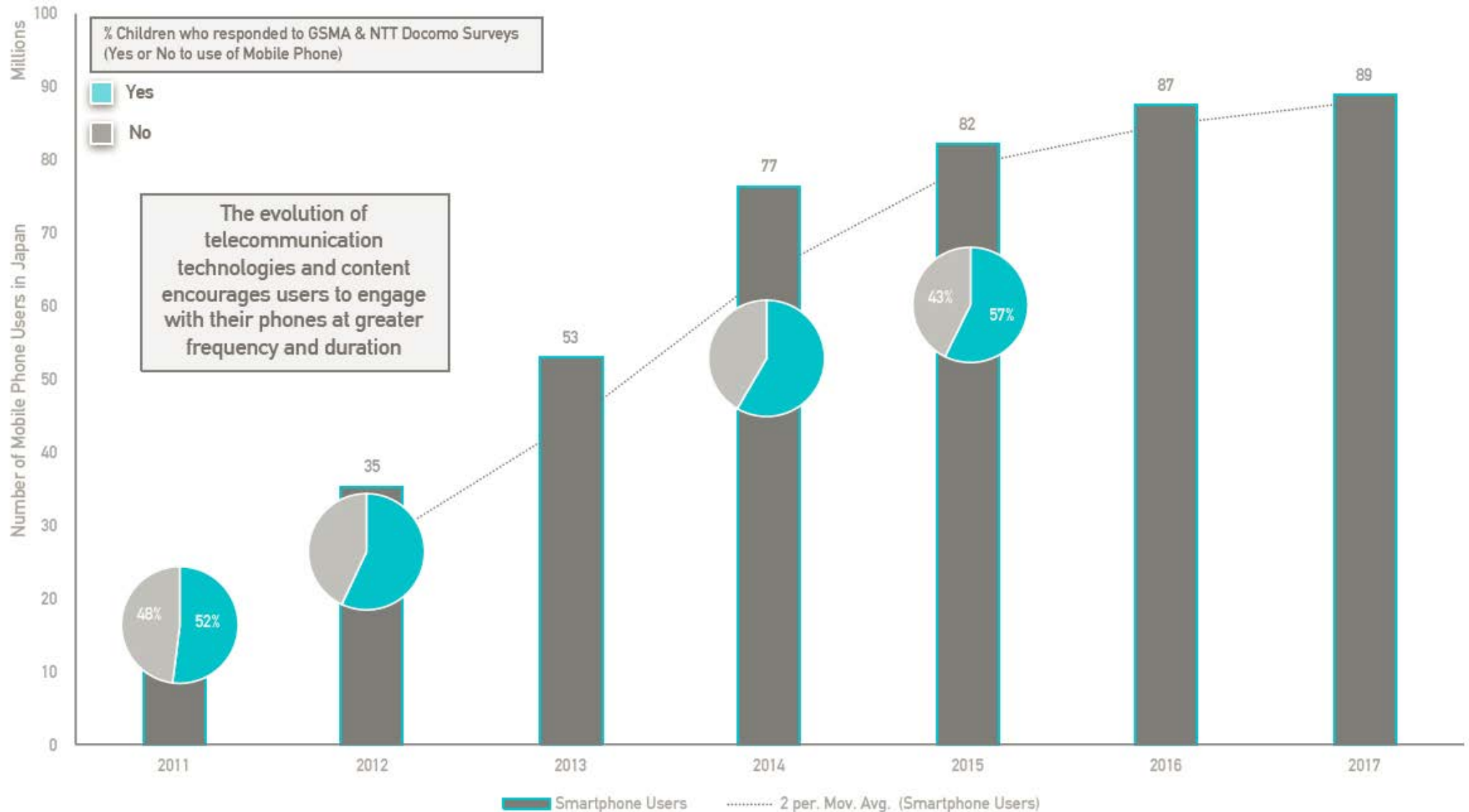
The socio economic costs of mobile phone over-use in terms of adolescent health, educational performance and subsequent unrealised economic growth

## RESPONSE

The avoided socio economic costs through Mobile Phone Safety Classes teaching optimal amongst Japanese adolescents

# Driver

## Smartphone Use: Total Population with Child Use Overlay



\* Please note the 2013 GSMA survey did not include results for Japanese children

# Driver

## Adolescence

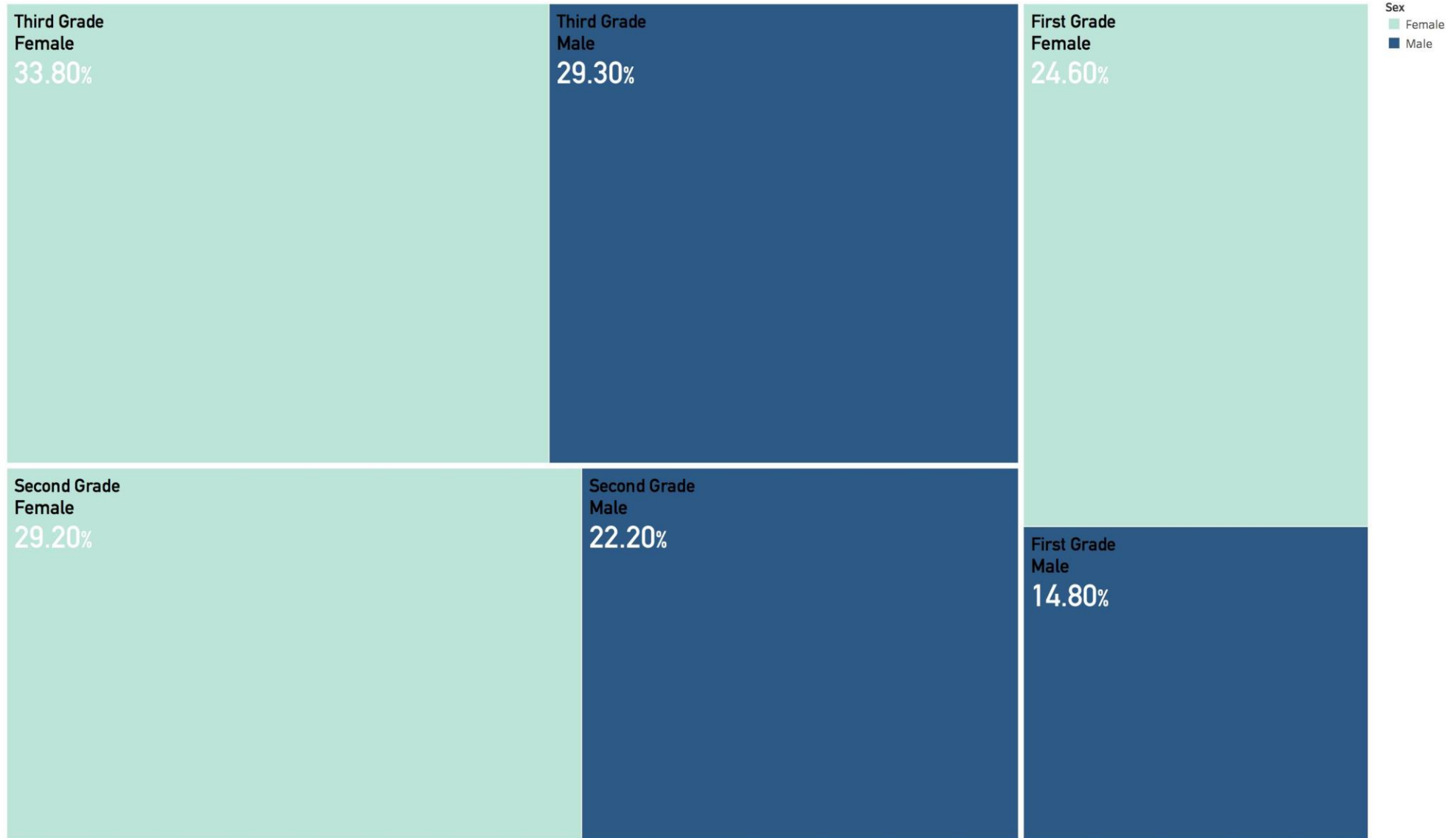
- *‘Adolescence is a time of increased independence and emergence of new social roles, all of which affect behaviour (sleep is no exception). Driven in part by this newly acquired autonomy, combined with delays in the circadian timing system and changes to the homeostatic sleep regulating system – bedtimes become later with each passing year’ (N.S. Foundation, 2006)*
- Tagaya et al suggest that “during adolescence, the sleep wake pattern changes dramatically [...] it has been reported that required sleep duration of adolescents for optimal daytime alertness is between 8.25 and 9.2 hours, and the intrinsic circadian timing system shows a phase delay that is associated with puberty.” (Tagaya et al. 2004)
- Kaneita et al. cite in France, Britain, Germany ‘25.7% of adolescents reported one or more of the following symptoms: Difficulty Initiating Sleep (DIS), Difficulty Maintaining Sleep (DMS), Early Morning Awakening (EMA) or non-restorative sleep. In China 16.9% of adolescents reported insomnia. (Kaneita et al 2004)
- Kaneita et al. surveyed 103,650 adolescents and found that “insomnia is common and associated with multiple factors” (Ibid.)
- The research suggests that children and notably adolescents are uniquely vulnerable to sleep disorders for a whole range of reasons physiological and environmental
- The increase in mobile phone use creates additional challenges for an already vulnerable demographic

The following slides will detail the prevalence of overuse of mobile phones and poor sleep quality amongst adolescents

# Pressure

## 'Short Sleepers'

Prevalence Of Short Sleepers: Perceived Sleep Duration Of Less Than 6 Hours (Tagaya et al., 2004)



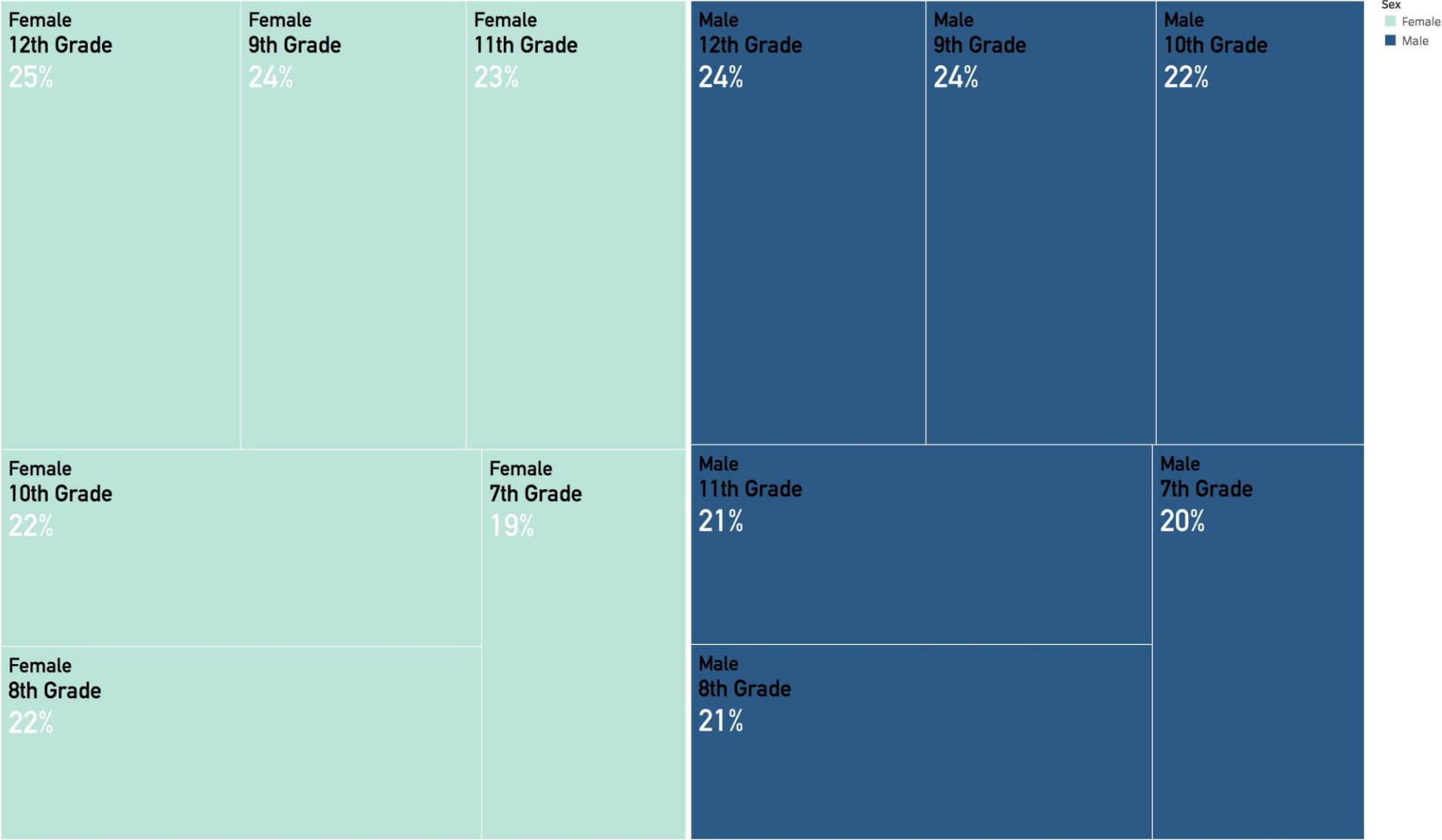
Grade, Sex and sum of Calculation1. Color shows details about Sex. Size shows sum of Prevalence of Short Sleep. The marks are labeled by Grade, Sex and sum of Calculation1. Details are shown for Grade and Sex.



# Pressure

## Insomnia

Percentage of Children Who Report Suffering From Insomnia (Munezawa, 2011)

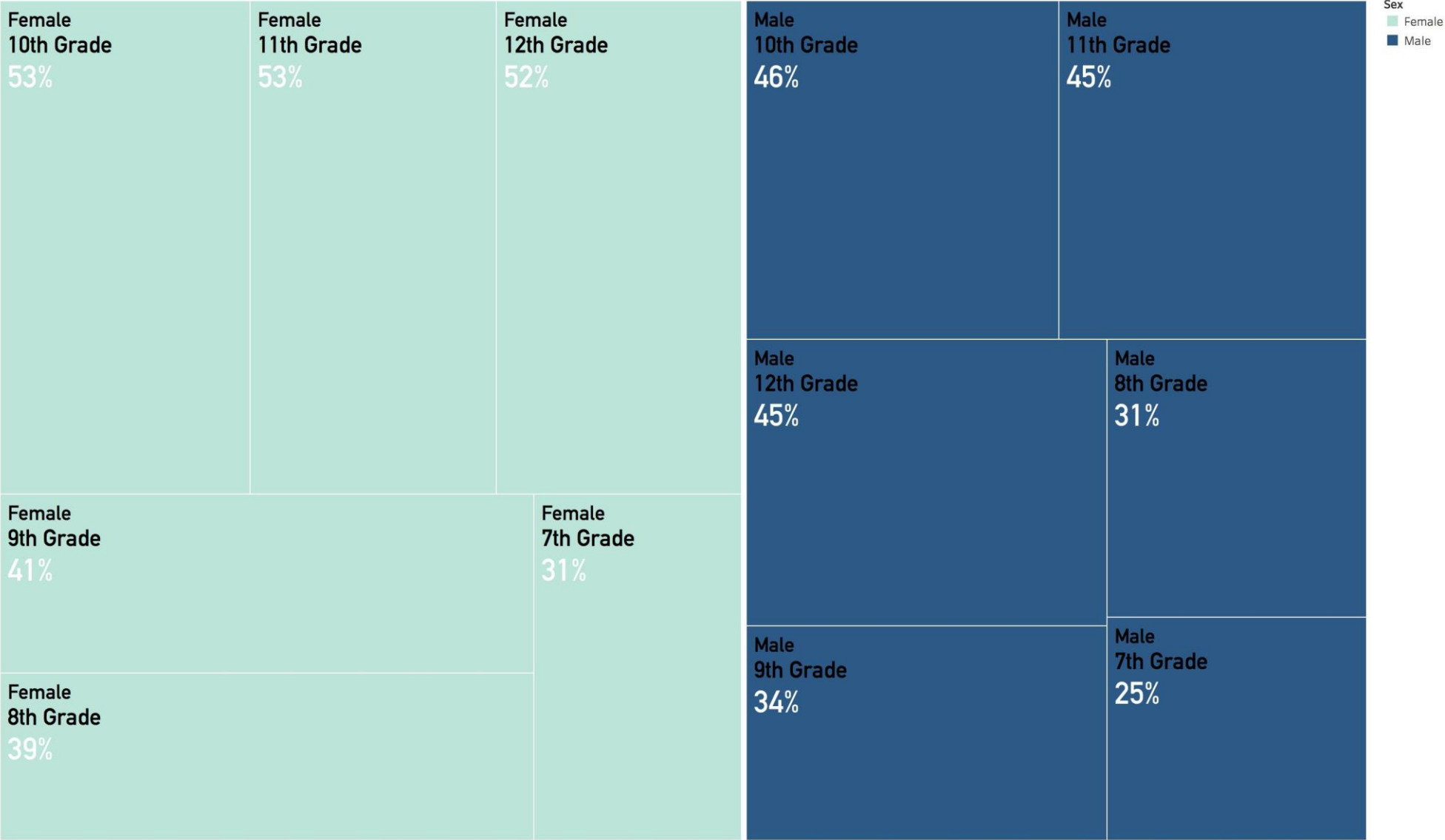


Sex, Grade and sum of Insomnia %. Color shows details about Sex. Size shows sum of Insomnia. The marks are labeled by Sex, Grade and sum of Insomnia %.

# Pressure

## Daytime Sleepiness

Percentage of Children Who Report Suffering From Daytime Sleepiness (Munezawa, 2011)

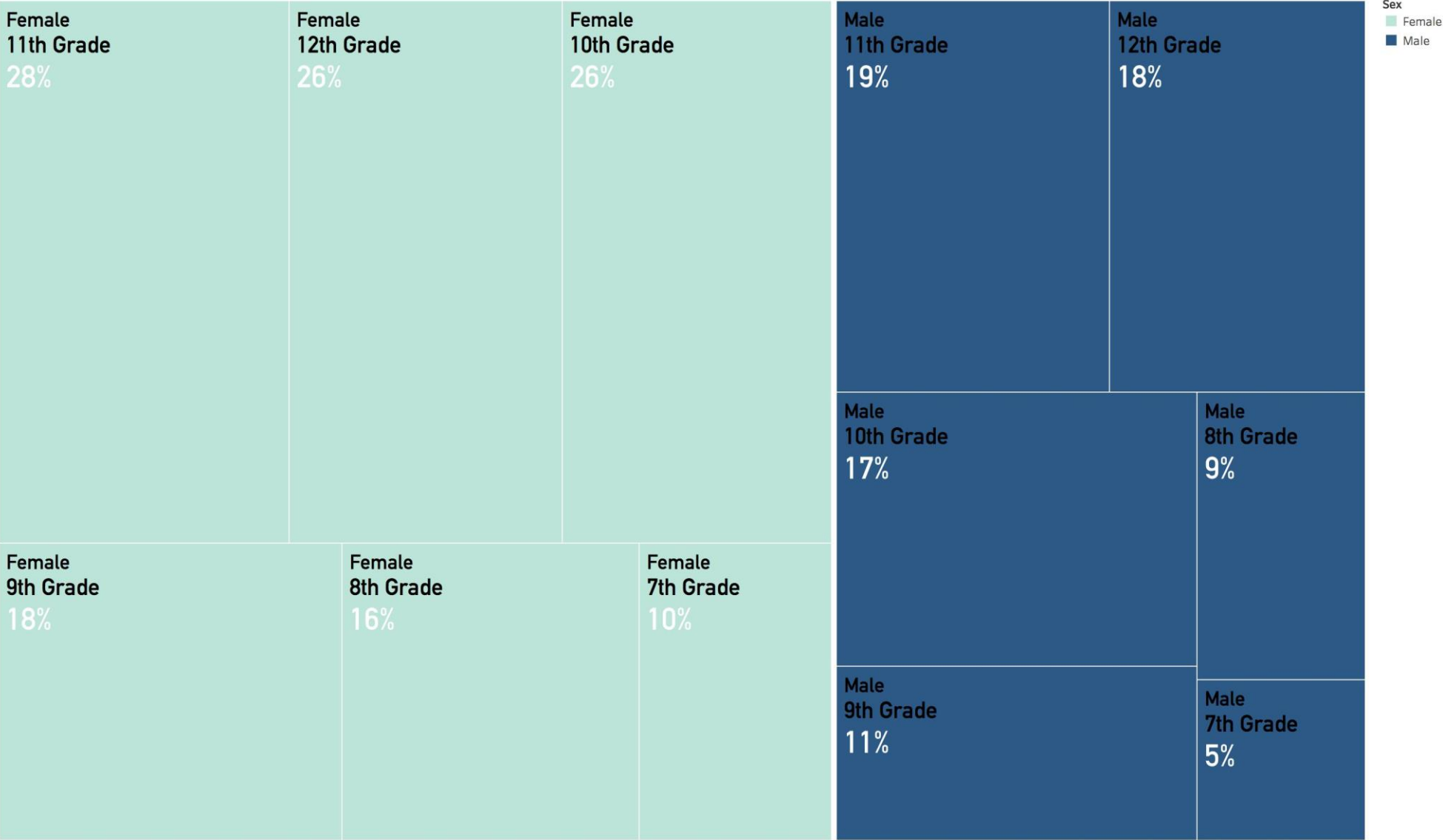


Sex, Grade and sum of Daytime calc. Color shows details about Sex. Size shows sum of Excessive Daytime Sleepiness. The marks are labeled by Sex, Grade and sum of Daytime calc.

# Pressure

## Mobile Phone Use: Text

Percentage of Children Who Text Every Day After Lights Out (Munezawa, 2011)

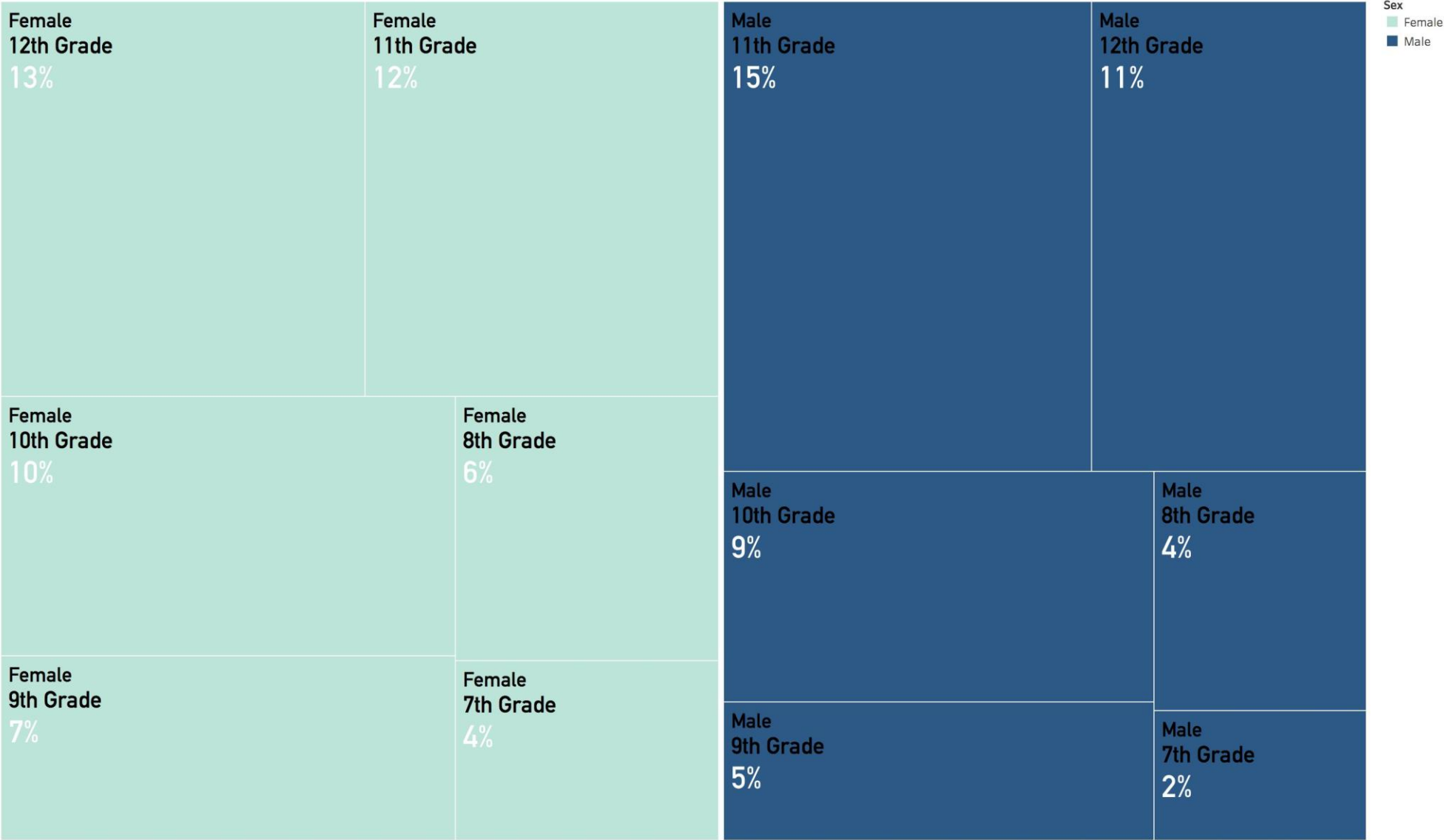


Sex, Grade and sum of Text calc. Color shows details about Sex. Size shows sum of Texting After Lights Out Every Day. The marks are labeled by Sex, Grade and sum of Text calc.

# Pressure

## Mobile Phone Use: Call

Percentage of Children Who Make Calls Every Day After Lights Out (Munezawa, 2011)

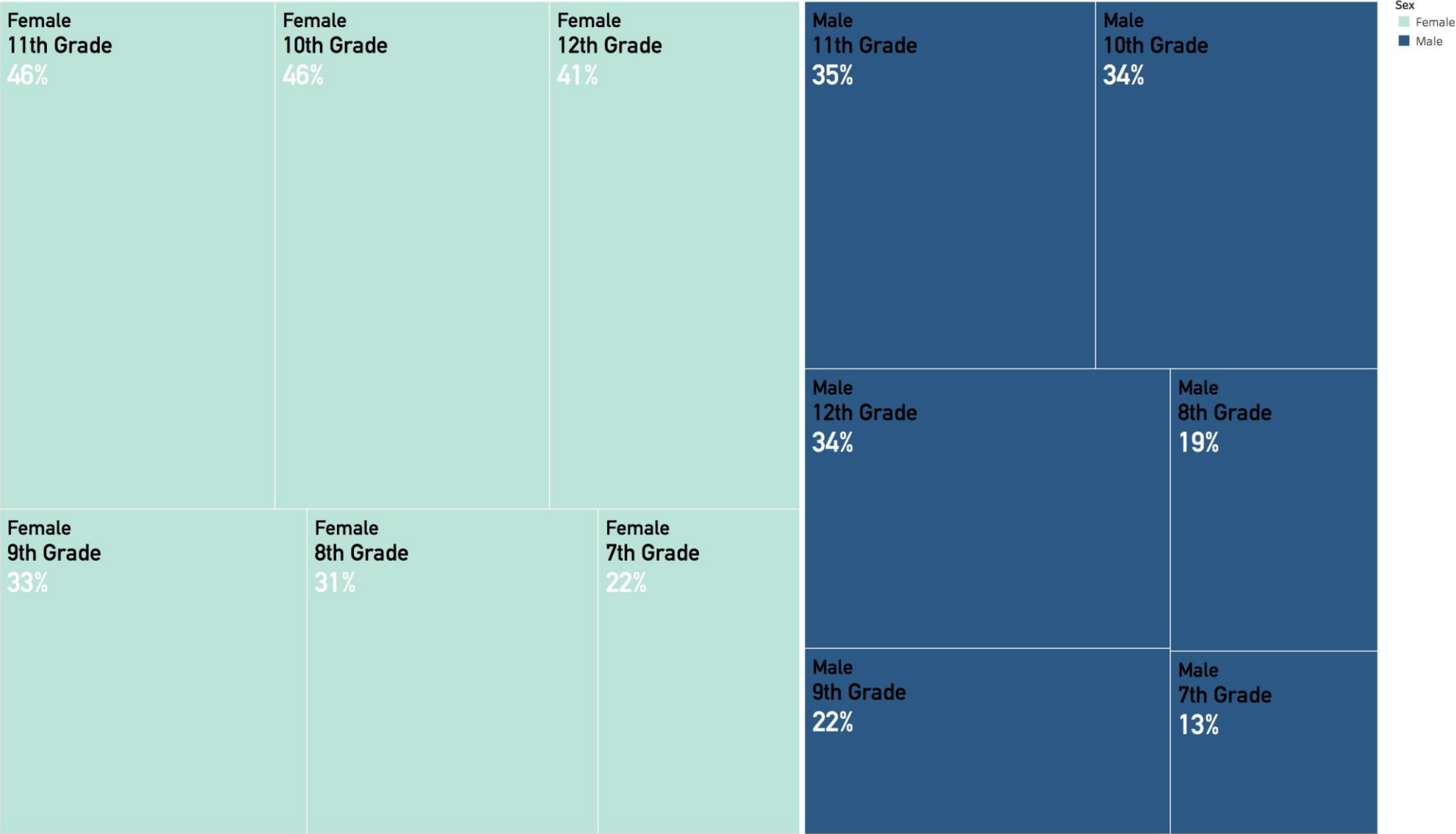


Sex, Grade and sum of Calculation2. Color shows details about Sex. Size shows sum of Calling After Lights Out Every Day. The marks are labeled by Sex, Grade and sum of Calculation2.

# Pressure

## Mobile Phone Use: More Than Two Hours Per Day

Percentage of Children Who Use their Phones For More Than Two Hours Per Day (Munezawa, 2011)



Sex, Grade and sum of Duration Calc. Color shows details about Sex. Size shows sum of Duration of Mobile Phone User after 1 Day. The marks are labeled by Sex, Grade and sum of Duration Calc.

# State

## National Estimates of Sleep & Over Use of Mobile Phones

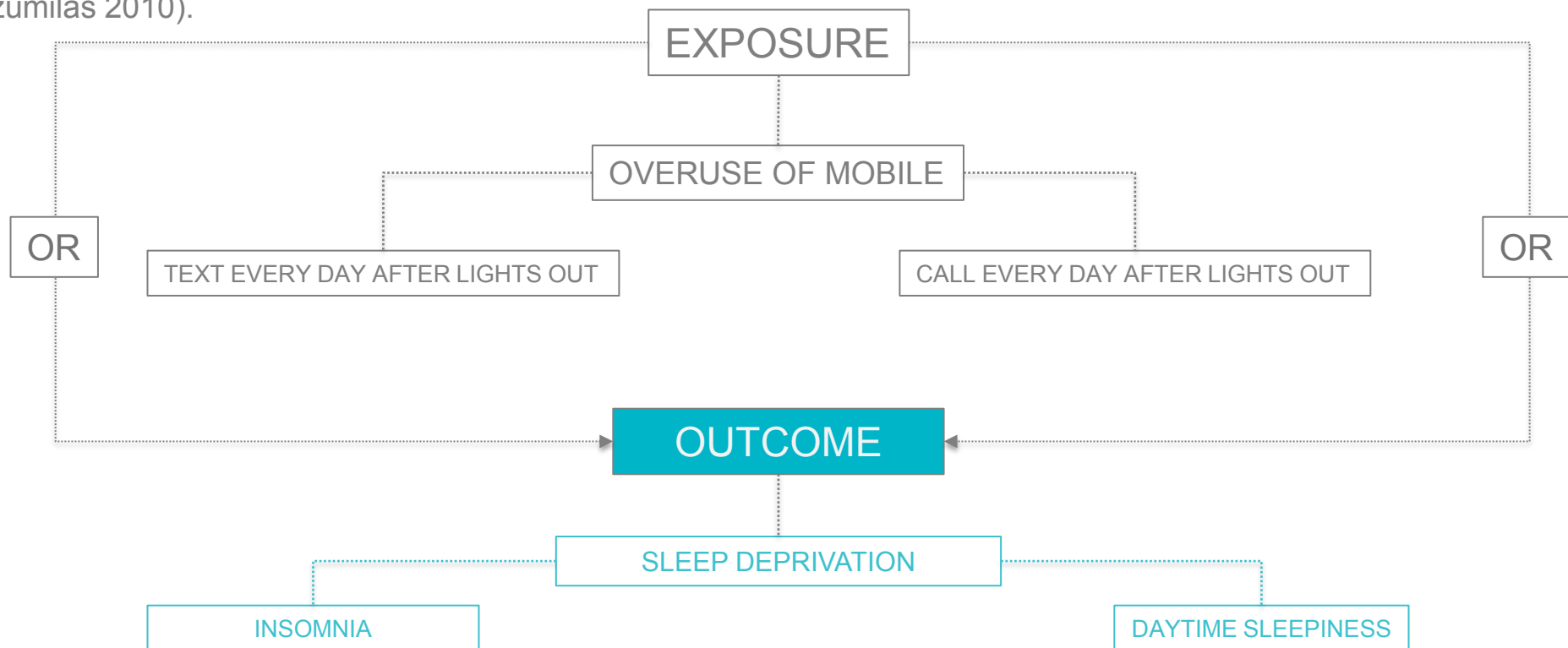
- The Ministry of Education reported [1,808,914] male pupils in lower secondary school and [1,727,268] females. In upper secondary school [1,672,326] males and [1,647,314] females were reported. (MEXT, 2014)
- These pupils have been distributed evenly amongst the different grades and categories as reported by Munezawa et al in their in the study on mobile phone use and sleep quality (as shown in graphics pages 9 -13) (Munezawa et al, 2011)
- For the purposes of this analysis, school children below 12<sup>th</sup> grade have been excluded because there exists less statistical association with poor sleep quality, mobile phone use, and the combination of both variables. Research shows that it is adolescents which suffer more from poor sleep and further are more likely to be negatively influenced by an overuse of mobile phones.

The National State of Mobile Phone Use & Sleep Quality						
Grade	Sex	Number of Children Who Call After Lights Out Every Day	Number of Children Who Text After Lights Out Every Day	Number of Children with Excessive Daytime Sleepiness	Number of Children with Insomnia	Total Students
7th	Male	14,471	28,943	151,949	117,579	602,971
8th	Male	26,531	51,856	188,730	126,624	602,971
9th	Male	31,355	66,930	202,598	143,507	602,971
10th	Male	47,940	96,995	256,423	119,850	557,442
11th	Male	83,616	105,357	251,964	119,293	557,442
12th	Male	62,434	98,667	249,177	134,901	557,442
7th	Female	23,606	58,151	179,060	107,091	575,756
8th	Female	34,545	89,242	222,818	124,363	575,756
9th	Female	42,030	103,636	238,363	135,303	575,756
10th	Female	56,009	141,669	293,222	121,352	549,105
11th	Female	66,442	152,651	289,378	125,745	549,105
12th	Female	68,638	143,316	286,633	137,825	549,105
Total		557,616	1,137,413	2,810,314	1,513,433	6,855,822

# State

## The Relationship Between Sleep and Mobile Phone Use

- Munezawa et al. performed logistic regression analysis to examine the relationship between overuse of mobile phones and sleep deprivation (Munezawa et al, 2011)
- Their results suggest that students who text every day after lights out had an odds ratio (OR) of 2.28 for daytime sleepiness and 2.28 for insomnia. For students who make calls every day after lights out, they had ORs of 2.12 for daytime sleepiness and 2.47 for insomnia.
- An OR is a measure of association between an exposure and an outcome. The OR represents the odds that an outcome will occur given a particular exposure, compared to the odds of the outcome occurring in the absence of an exposure. (Szumilas 2010).



# State

## The Relationship Between Sleep and Mobile Phone Use

- The table below shows the results of applying the ORs to the variables using national data on the number of pupils.
- Two combination's of variables will be carried forward:
- The fourth column is selected to demonstrate the relative impact on education because 'daytime sleepiness' has the most logical association with a reduction in academic performance. Further 'texting' rather than calling is more associated with late sleep due to viewing a bright screen. For example, Wah Mak et al (2014) found that "mobile phone **viewing** duration was correlated with sleep duration, quality and daytime sleepiness [...] **bright light can affect the sleep-wake cycle through the suppression of the nocturnal salivary secretion of melatonin which contributes to sleep disturbances**' (Wah Mak, 2014)
- The 6<sup>th</sup> column is selected to assess the impact of insomnia amongst adolescents for the same medical reasons relating to screen brightness

Grade	Sex	Percentage of Children Who Call After Lights Out Every Day and Have Excessive Daytime Sleepiness	Percentage of Children Who Text After Lights Out Every Day and Have Excessive Daytime Sleepiness	Percentage of Children Who Call After Lights Out Every Day and Have Insomnia	Percentage of Children Who Text After Lights Out Every Day and Have Excessive Insomnia	Total Students
7th	Male	1%	2%	1%	2%	602,971
8th	Male	3%	4%	2%	4%	602,971
9th	Male	4%	6%	3%	6%	602,971
10th	Male	8%	9%	5%	9%	557,442
11th	Male	14%	9%	8%	9%	557,442
12th	Male	11%	10%	7%	10%	557,442
7th	Female	3%	4%	2%	4%	575,756
8th	Female	5%	8%	3%	8%	575,756
9th	Female	6%	10%	4%	10%	575,756
10th	Female	12%	13%	6%	13%	549,105
11th	Female	14%	15%	7%	15%	549,105
12th	Female	14%	15%	8%	15%	549,105
Total Number of Students		528,101	584,651	310,520	584,651	6,855,822



# Impact

## The Relationship Between Mobile Phone Use and Sleep Quality

- Estimating the health care costs of insomnia related to adolescents without an understanding of whether they are undergoing treatment is challenging. To achieve this a study from the United States has been used a base cost which is then deflated to account for health care costs by age. The study was selected because it details the cost attributed to untreated insomnia, we therefore avoid assumptions of the prevalence of treatment in insomniacs.
- *Botteman et al* 'developed a decision analytical model based on a 6-month sleep efficacy data from study in 800 patients with primary insomnia, they suggest the total direct medical cost attributed to untreated primary insomnia in 6 months versus costs in individuals without insomnia was USD 1,453 per person' (Botteman et al 2006). Adjusting for inflation and exchange rates this equals JPY [195,342] per person.
- The health expenditure per capita in the US is currently (2015) USD 9,451, in Japan it is JPY 440,055 or USD 3,667 (using a 2015 exchange rate of 120). This means that US expenditure per capita is 2.6 times greater than Japan. (OECD STAT)
- Using this ratio of 2.6 as a deflation mechanism we can estimate that the 6 month untreated cost of insomnia for Japanese adults is JPY [75,131].
- In order to account for the difference in health expenditure by age a ratio of 0.28 has been used because (Ibuku et al 2016) show mean medical expenditure to be 0.28 times less for 0-24 year olds vs 25-64 year olds (the latter age group is comparable to Botteman's sample demographic).
- Using this further deflation mechanism it is estimated that the total 6 month cost of an untreated adolescent insomniac is JPY [21,453]

# Impact

## The Relationship Between Mobile Phone Use, Sleep Quality and Educational Attainment

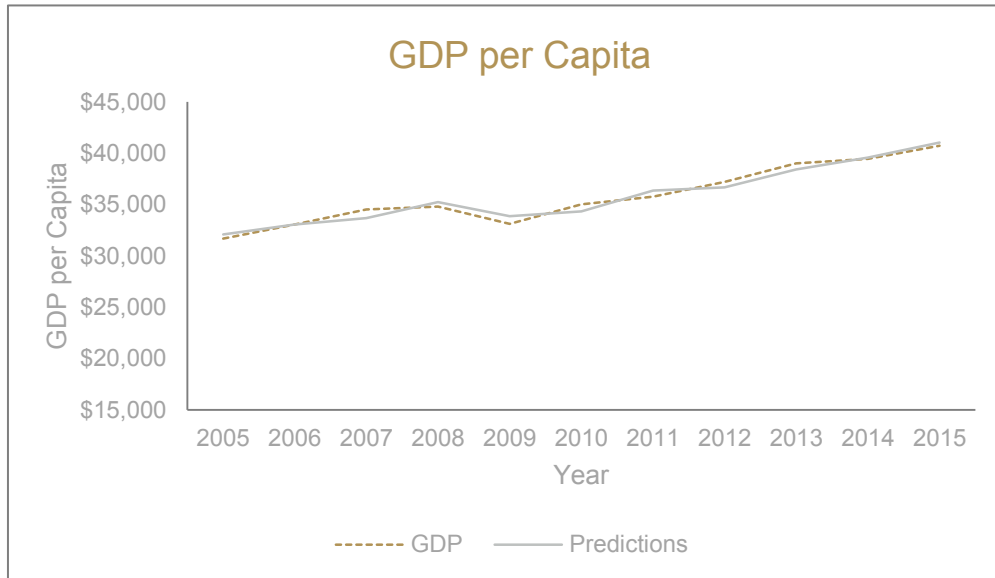
- Rikkyo University found that students who use their smartphone for less than 30 minutes a day averaged a score of 60.7% while students who use their smartphones for more than four hours per day scored 43.7%. (Japan Today 2015)
- Tohoku University found that students who studied more than two hours per day but who used their smartphones less than one hour per day scored an average of 70 points. Students who studied for the same duration but used their phone for two to three hours per day scored on average 10 points less. (Ibid)
- Pagel and Kwiatkowski report there to be a growing body of research that demonstrates students who report daytime sleepiness perform worse in school. (Blum et al., 1990; Link and Ancoli-Israel, 1995; Hoffamn and Steenhof, 1997; Wolfson and Carskadon, 1998, 2003; Shin et al., 2003; Millman, 2005).
- In their study they found the students who reported 'falling asleep in class', 'have trouble with sleepiness' and 'hard to wake up in the morning' were consistently scoring lower test scores than their counterparts. The study was based in the US but the age group of students is the same as in this study. (Pagel and Kwiatkowski 2010)
- A Korean study showed that 'Excessive Daytime Sleepiness' was significantly more prevalent (5%) in the students who were scoring low grades than those who were not. (Shin et al, 2003).
- It is well documented that there is a significant negative association with overuse of mobile phone, sleep and poor academic performance.
- For the purposes of this analysis, the 10 percentage points reported by Tohoku university will be carried forward because the survey group is Japanese and the exposure is directly related to overuse of mobile phones.
- This suggests that the 584,651 students in Japan who are estimated to suffer daytime sleepiness as a result of using their mobile phone excessively at night perform 10% worse in their exams. This assumption is wholly consistent with the prevailing literature.

# Impact

## The Relationship Between Educational Attainment and Economic Performance

There is a highly significant association with economic growth and educational attainment. For example, the levels of adults with tertiary education, of which a prerequisite is secondary education, is shown to significantly correlate with GDP growth. (Pearson correlation of 0.92 over a time series of 2005-2015). Further, youth unemployment which is a logical outcome of a poor education system is highly negatively correlated with GDP per capita. These two variables have been used in a multiple linear regression model using the statistical programming language 'R'. The results can be found below.

Please note this regression model should only be used for purposes of demonstrating an association, the model has not gone through all the necessary testing required to be used for any forecasting applications. Please see the appendix for the adjusted R squared value.



Source Data for the Multiple Regression Model (Japan)				
Year	GDP per Capita	GDP per Capita (Predictions)	Tertiary Education Levels	Youth Unemployment
2005	\$31,668	\$40,783	40	9%
2006	\$33,062	\$41,109	40	8%
2007	\$34,535	\$41,453	41	8%
2008	\$34,804	\$42,565	43	7%
2009	\$33,103	\$43,107	44	9%
2010	\$35,004	\$43,742	45	9%
2011	\$35,775	\$44,699	46	8%
2012	\$37,214	\$44,856	47	8%
2013	\$39,008	\$45,291	47	7%
2014	\$39,435	\$45,829	48	6%
2015	\$40,737	\$46,662	50	6%

This graph shows GDP per capita is USD for Japan and the historic predictions of GDP per capita using the independent variables of 'adults with tertiary education', and 'youth unemployment'. It demonstrates a significant statistical association with the outcomes of education and economic growth.

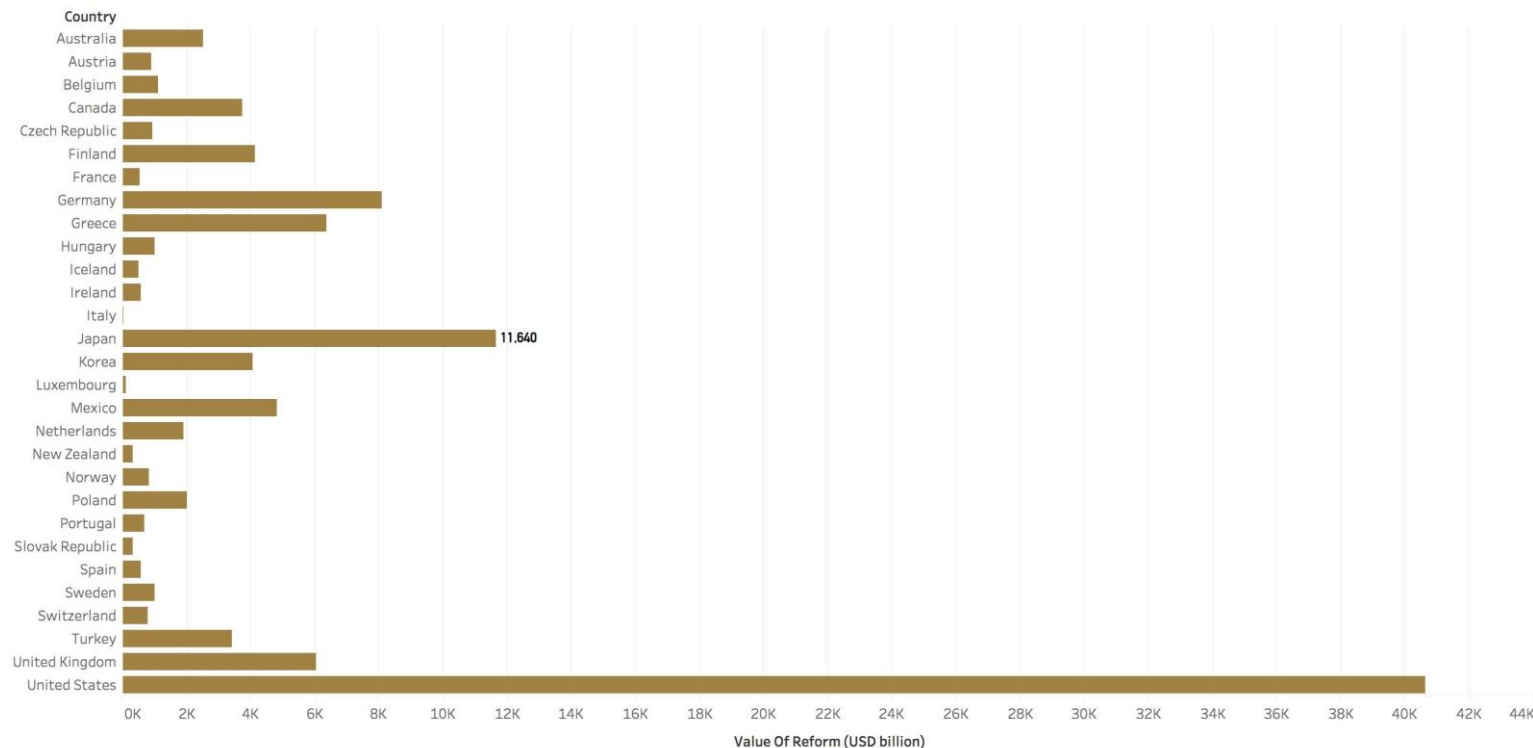
Multiple Regression Model Output				
term	estimate	std.error	statistic	p.value
(Intercept)	16548.00352	4439.730025	3.727254456	0.005810586
Tertiary Education	608.9933801	74.49066245	8.175432464	3.73E-05
Youth Unemployment	-1017.667889	206.3278716	-4.932285112	0.001146137

# Impact

## Education and Economics

- The prevailing research demonstrates a highly significant association with educational attainment and economic growth, principally measured in GDP
- The OECD assessment of 'The High Cost of Low Educational Performance' creates scenarios of a fully implemented educational reform program and the expected financial returns
- The results of scenario 1 are presented below and show a significant economic impact through increased academic attainment throughout secondary school. These results are also presented on a map on the following page

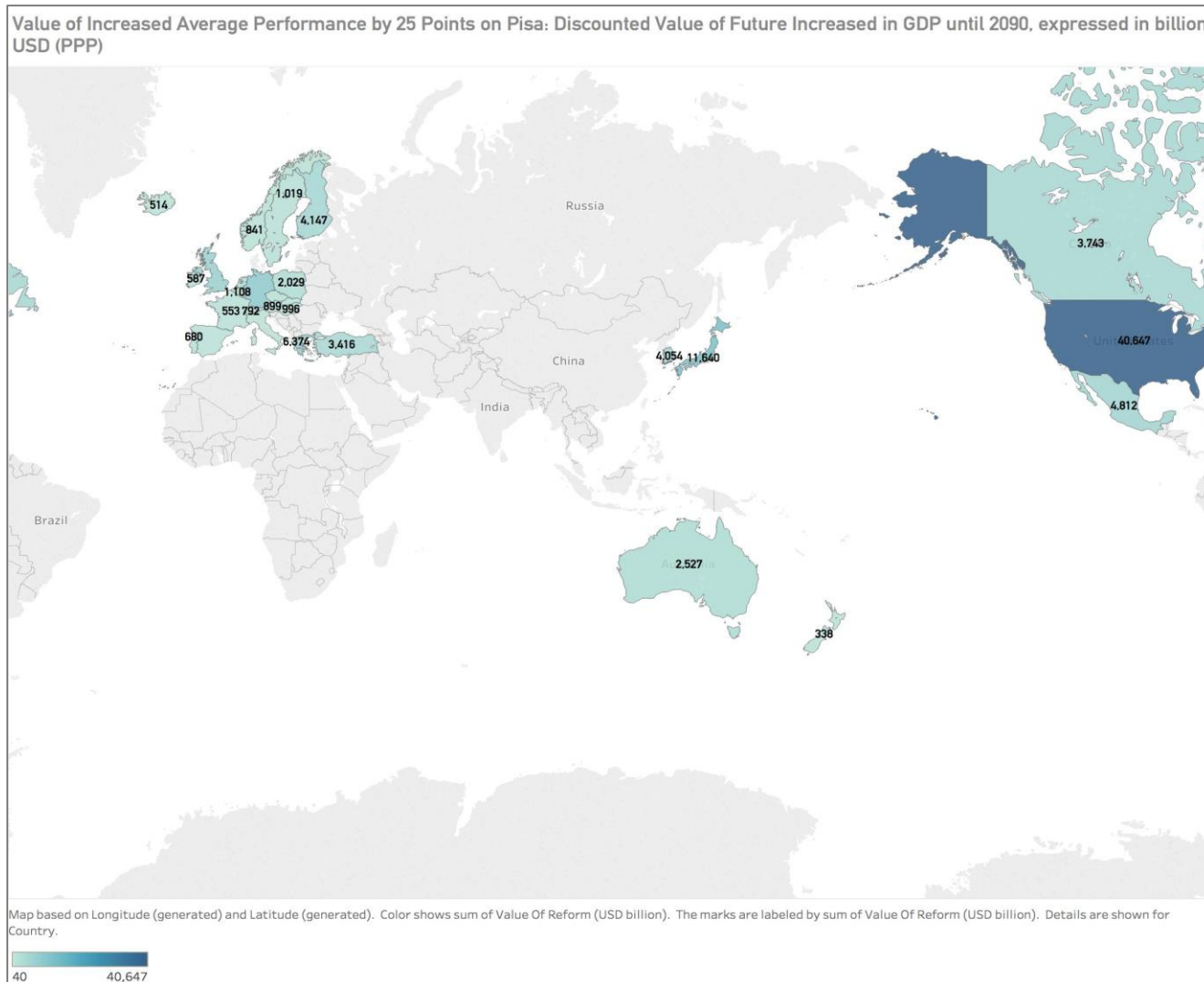
Value of Increased Average Performance by 25 Points on Pisa: Discounted Value of Future Increased in GDP until 2090, expressed in billion USD (PPP)



Sum of Value Of Reform (USD billion) for each Country.

# Impact

## Education and Economics

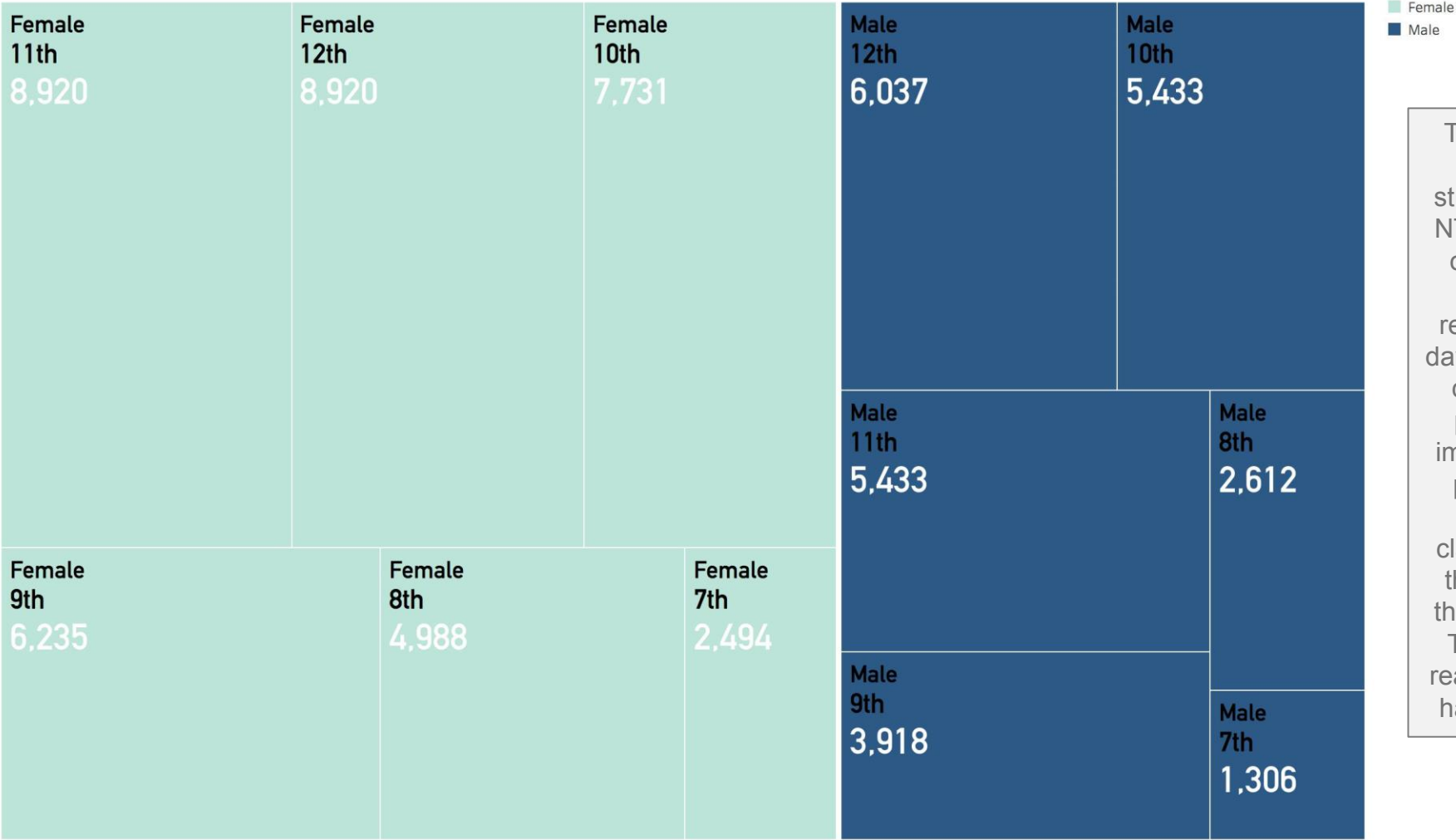


- These economic growth figures relate to the extra workplace innovation as a result of a reform of the education system measured in an increase in PISA points.
  - PISA is the OECD Programme for International Student Assessment
  - Japan consistently outperforms the average.
- Since PISA and the current Japanese exams cannot be fully comparatively assessed; and the growth figures rely on an entire age cohort achieving at a certain level, the increased attainment as a result of the mobile phone safety class cannot be confidently valued.
- That said, it goes beyond doubt that any efforts to increase academic performance will have a positive economic impact on Japanese society once the children reach working age,

# Response

## Estimating the Number of Class Participants Who Improve Exam Results

Number Of Students With A Reduction of 10% In Academic Performance Resulting From Overusing Mobile Phones



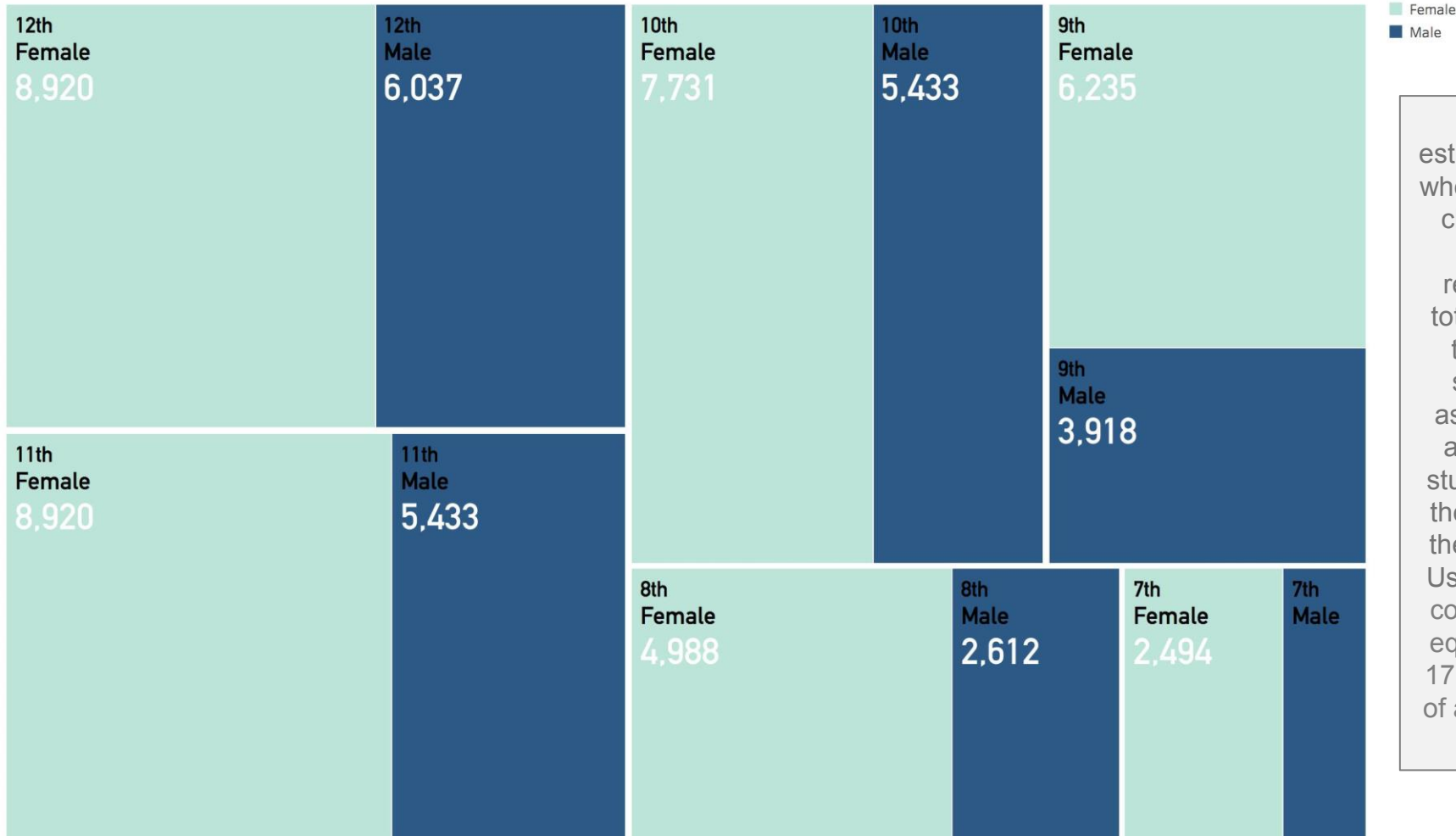
This graphic shows the estimated number of students who prior to the NTT Docomo class were overusing their mobile phones at night. This resulted in experiencing daytime sleepiness, which combined with mobile phone use negatively impacted their academic performance by 10%. Having attended the class, it is now assumed the students will regain these percentage points, The benefit in terms of realised economic growth has not been calculated

Sex, Grade and sum of Number of Students Performing 10% Worse in Exams as a Result of the Exposure. Color shows details about Sex. Size shows sum of Number of Students Performing 10% Worse in Exams as a Result of the Exposure. The marks are labeled by Sex, Grade and sum of Number of Students Performing 10% Worse in Exams as a Result of the Exposure.

# Response

## Estimating the Number of Class Participants Who Have Reduced Insomnia Symptoms

Number Of Participants Who Text Every Night & Have Insomnia



This graphic shows the estimated number of students who prior to the NTT Docomo class were overusing their mobile phone at night, resulting in insomnia. The total number is the same as those who have daytime sleepiness [64,027]. It is assumed that as a result of attending the class, these students are no longer using their phone excessively and their insomnia has desisted. Using the 6 month untreated cost of adolescent insomnia equal to JPY [21,131] (page 17) the total benefit (in terms of avoided costs) equals JPY [1.3] billion

Sum of Number of Participants Who Text After Lights Out Every Day and Have Excessive Insomnia, Grade and Sex. Color shows details about Sex. Size shows sum of Number of Participants Who Text After Lights Out Every Day and Have Excessive Insomnia. The marks are labeled by sum of Number of Participants Who Text After Lights Out Every Day and Have Excessive Insomnia, Grade and Sex. Details are shown for Grade and Sex. The view is filtered on Exclusions (Grade,Sex), which keeps 12 members.

# Summary

- Adolescents are at a vulnerable stage in their personal development, undergoing physiological and environmental changes that make sleep disorders prevalent.
- The overuse of mobile phones exacerbates sleep disorders, notably insomnia and excessive daytime sleepiness.
- These conditions affect academic attainment, which is a key driver of economic growth.
- NTT Docomo's mobile phone safety class is estimated to have improved the grades of [65,027] adolescents by 10% and this will have a notable economic impact on Japanese society when the children reach adulthood and enter the workforce
- Untreated adolescent insomniacs are estimated to spend JPY [21,037] more on health costs over a period of six months than those without the sleep disorder.
- NTT Docomo's class is estimated to prevent the same [65,027] adolescents from becoming insomniacs through teaching the correct use of mobile phones and this equates to a social benefit of JPY [1.3] billion (in terms of avoided health costs) and representative of one dimension of their Value To Japanese Society



# Limitations

## 1. The study fell short of providing an economic assessment of an improvement in students grades

- Too many assumptions would have had to be made to draw a confident link between the prevailing valuation work and the NTT Docomo class and therefore, given constraints, this analysis finds a qualitative assessment of benefit to be more appropriate.
- A quantitative understanding could be achieved through an understanding of student grades, graduates and relative earnings related to schools.

## 4. Societal Benefits Of Avoided Health Costs facilitated by Aruite Otoku

**Driver-Pressure-State-Impact-Response**  
**Societal Benefits Of NTT Docomo's Select Services**

# Executive Summary

- Physical activity is both a curative and preventative solution to health problems, particularly common afflictions of society, such as diabetes, heart failure and obesity.
- In 2016 the **Aruite Otoku** mobile application is estimated to have encouraged **[19,346]** of its **[48,653]** users to increase their step count by over **[3,000]** daily steps.
- This increase in physical activity reduces associated health costs by **[8.4%]**
- After adjusting for statistical prevalence rates of diabetes, heart failure and obesity this analysis finds that a total of **[1,112]** users would have avoided health costs.
- These avoided health costs, conceived as a societal benefit originated by NTT Docomo and representative of one dimension of their **Value To Japanese Society**, equates to **[JPY 59 million]**
- The following slides will detail how this conclusion was reached

# Overview

## Driver-Pressure-State-Impact-Response [DPSIR]

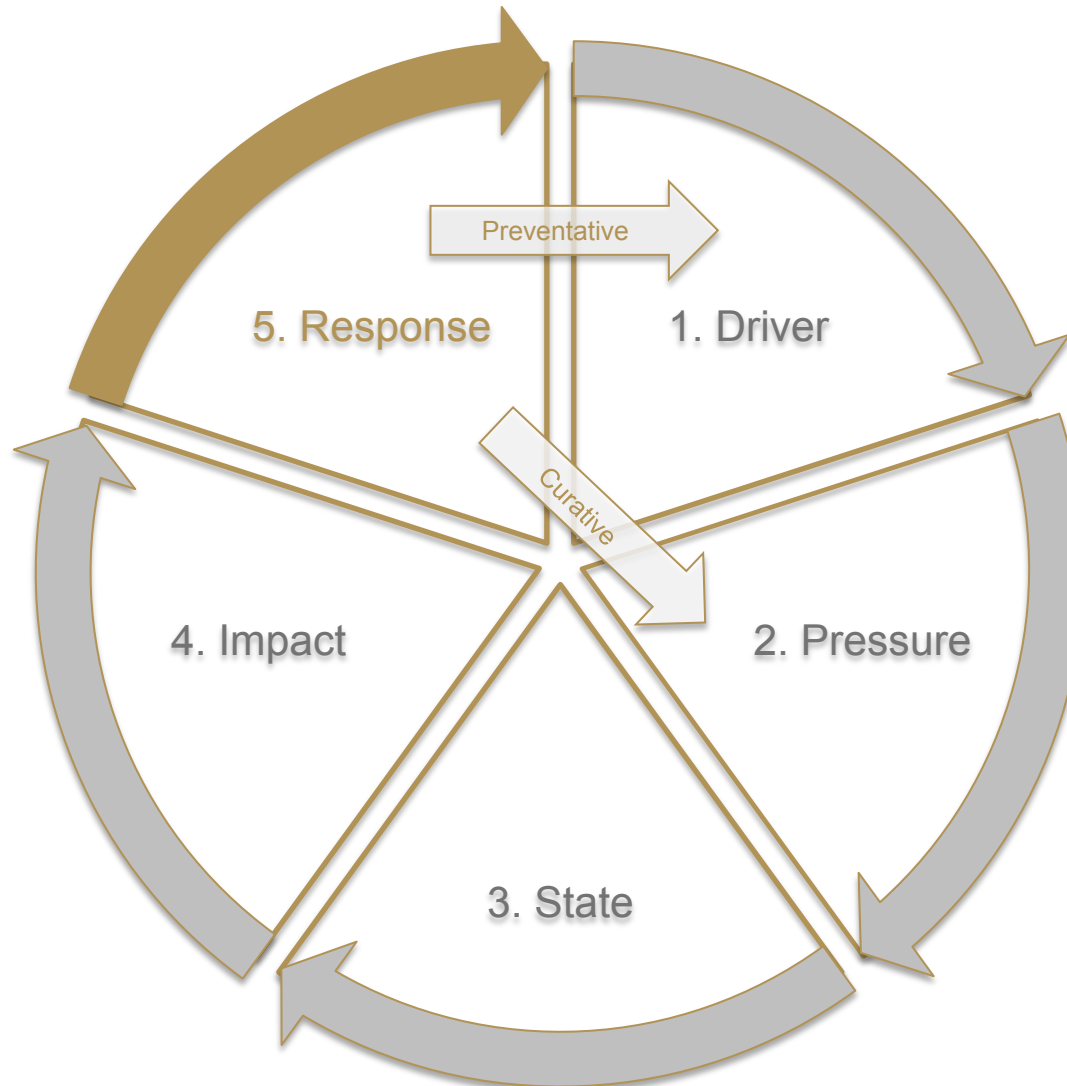
**Step 5: Response**  
e.g. Aruite Otoku encourages users to increase their daily step count. The physical exercise induced is a curative solution improving the health of the users.

**Step 1: Driver**  
e.g. Consumer lifestyles

**Step 2: Pressure**  
e.g. Increasing levels of obesity, inactivity, depression, and disease.

**Step 4: Impact**  
e.g. The socio-economic impacts of poor health.

**Step 3: State**  
e.g. Population suffering from disease and depression.



- the DPSIR approach is non-linear, reflecting the cyclical nature of socio-economic impacts and their respective drivers -

# Flow of Analysis

## DRIVER

Evidence of shifting consumer preferences for less active lifestyles and towards faster (less nutritious) foods

## PRESSURE

Evidence of the increasing number of cases of diabetes and obesity and, although decreasing, high prevalence of heart disease

## STATE

The current population suffering from diabetes, heart disease and obesity

## IMPACT

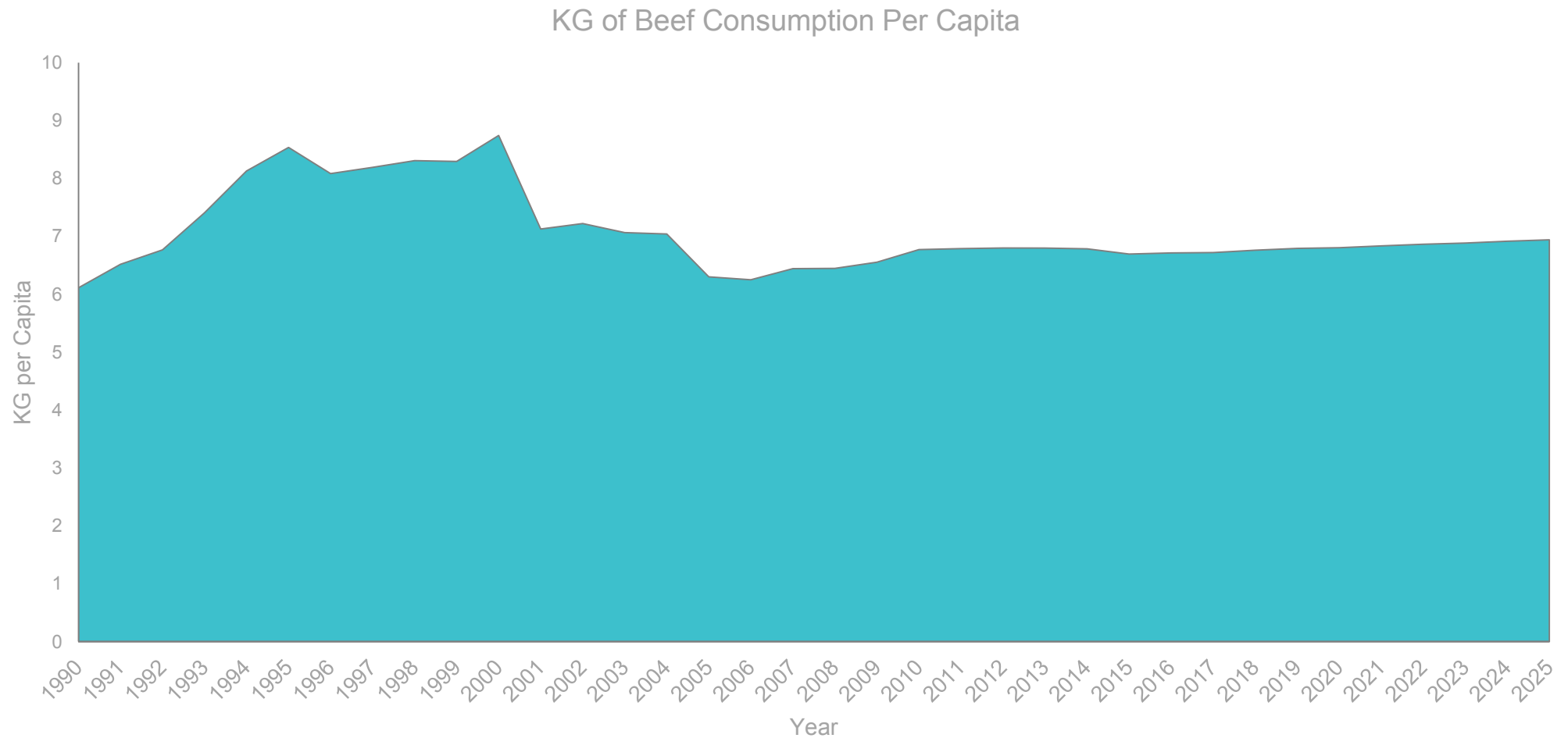
The socio-economic costs of the changes in health status of the population

## RESPONSE

Application of the socio-economic costs to the number of App users, adjusting for step increase and prevalence of disease.

# Driver

## Changing Consumer Lifestyles



Consumer preferences show a recent steady increased trend towards the consumption of red meat after a decrease in 2006. This has been linked to an increased preference towards eating fast 'convenience' food.

## Driver

### Changing Consumer Lifestyles

In 2014 and 2015 there were food safety scandals which lead to a decrease in hamburger sales from JPY 6.9 billion in 2012 to JPY 5.5 billion in 2015. However 2016 witnessed a resurgence in sales up to JPY 5.9 billion. (USDA Foreign Agricultural Service, 2016)

Fast food pizza companies such as Dominos and Pizza Hut increased their sales from by 18.9% and 8.8% from 2015 to 2016 with a combined market share of 41.8%, and combined sales of JPY 67 billion. (USDA Foreign Agricultural Service, 2016)

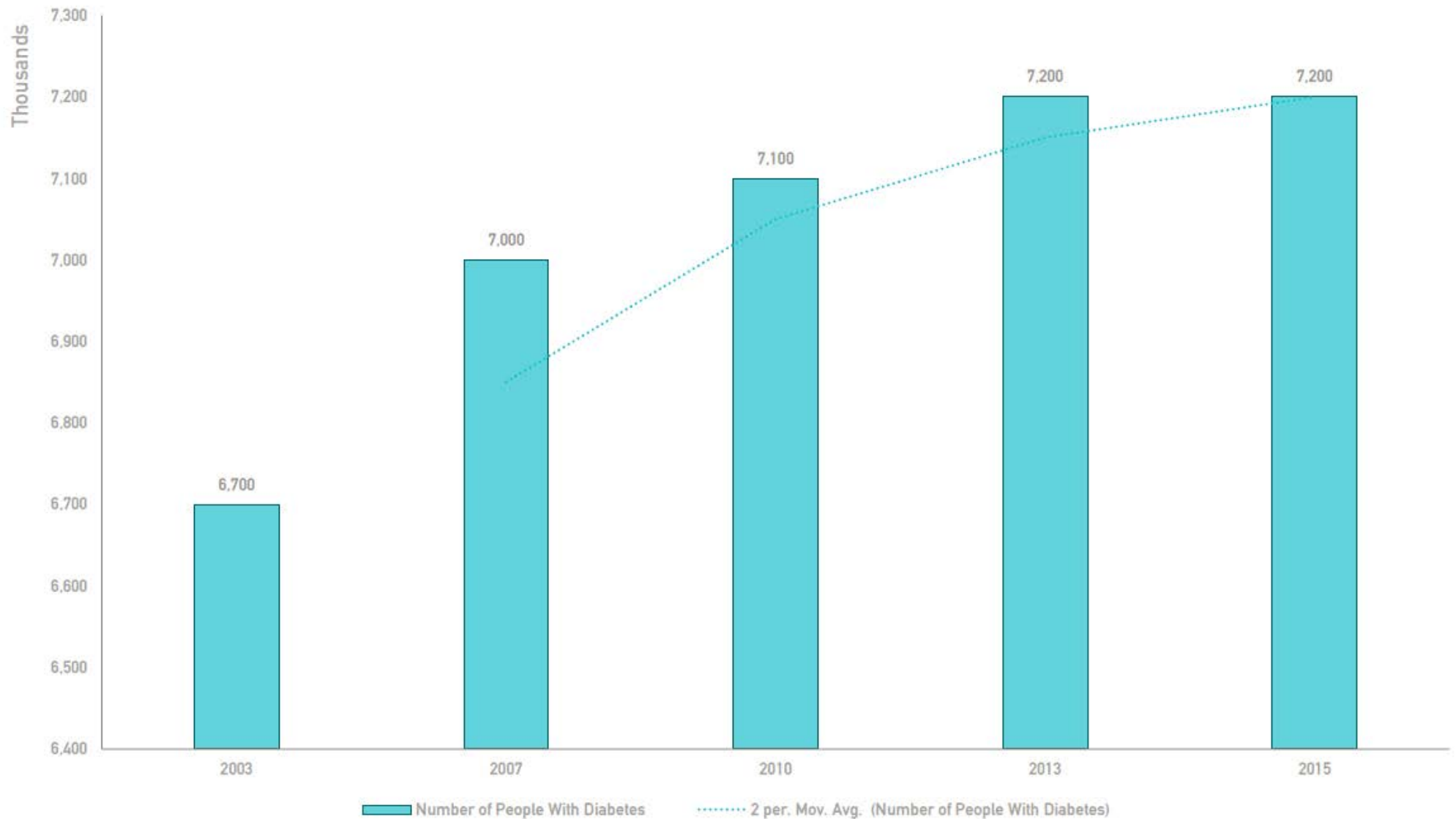
**A clear trend of increasing fast 'convenience' food exists**

Euromonitor suggest that “fast food is projected to see a 2% constant value compound annual growth rate over 2016-2021 to reach sales of JPY 5,287 billion. (Euromonitor, 2016)

Japan is reported to be one of the most healthy countries in the world, however the combination of an ageing population and increased consumption of fast-foods is part responsible for driving levels of obesity and diabetes upwards.

# Pressure

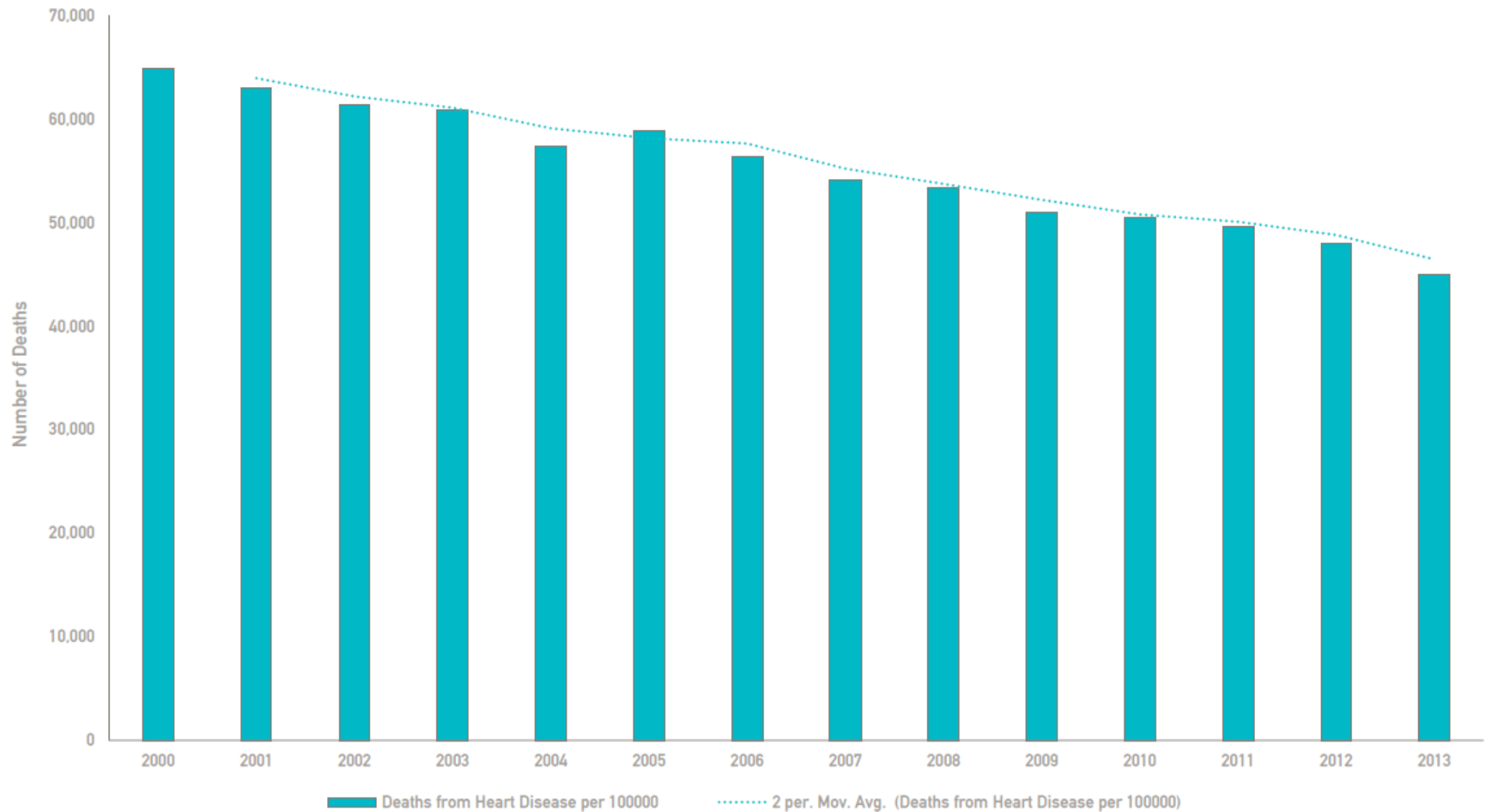
## Number Of People With Diabetes





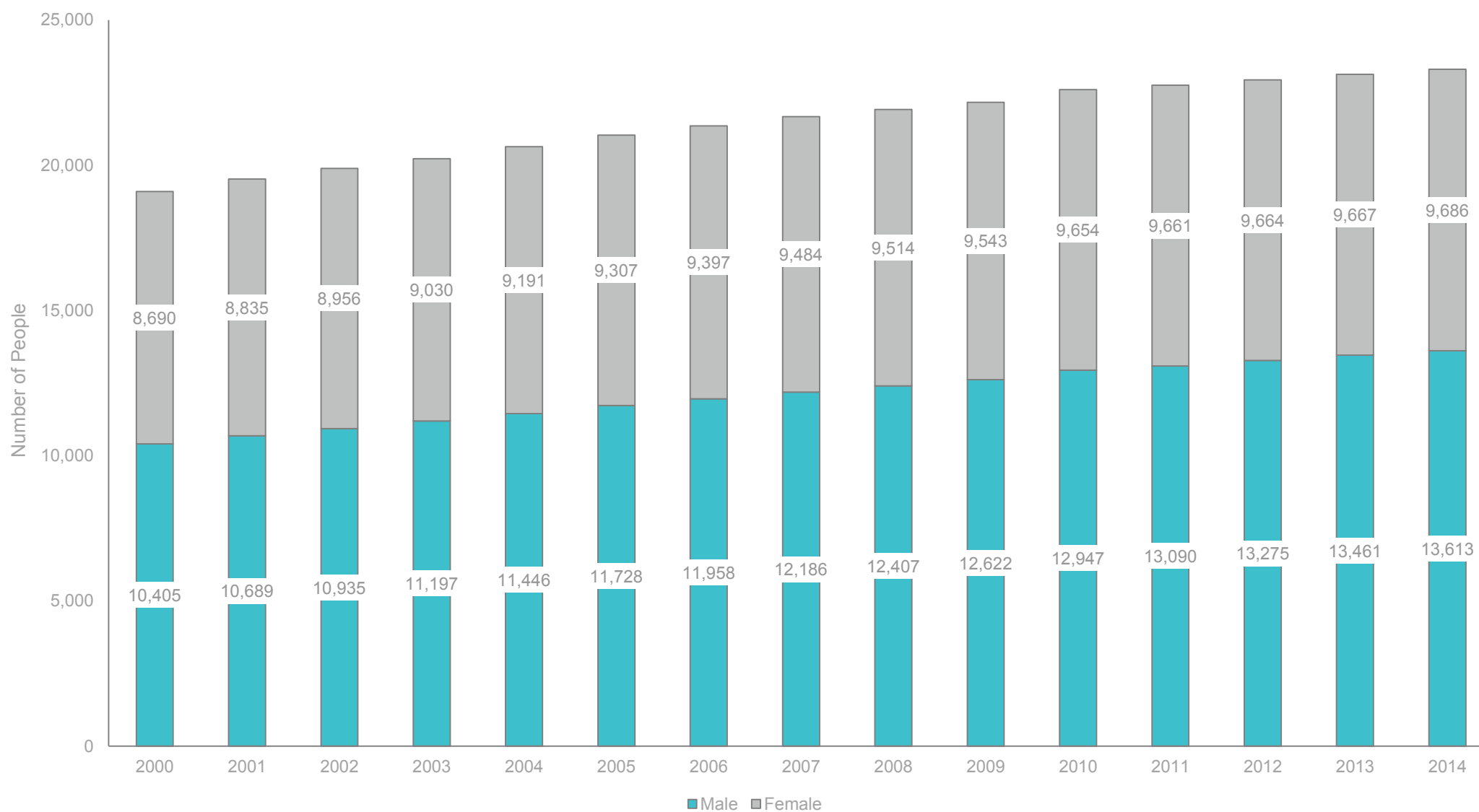
# Pressure

## Deaths from Ischemic Heart Disease



# Pressure

## Overweight Population / Obesity: Body Mass Index Exceeding 25



# State

## The State of Ischemic Heart Disease, Diabetes, Obesity and Suicide

In 2013 44,953 people died from Ischemic heart disease (heart failure)

In 2014 there was a total of 13,613 males afflicted with obesity, and 9,686 females.

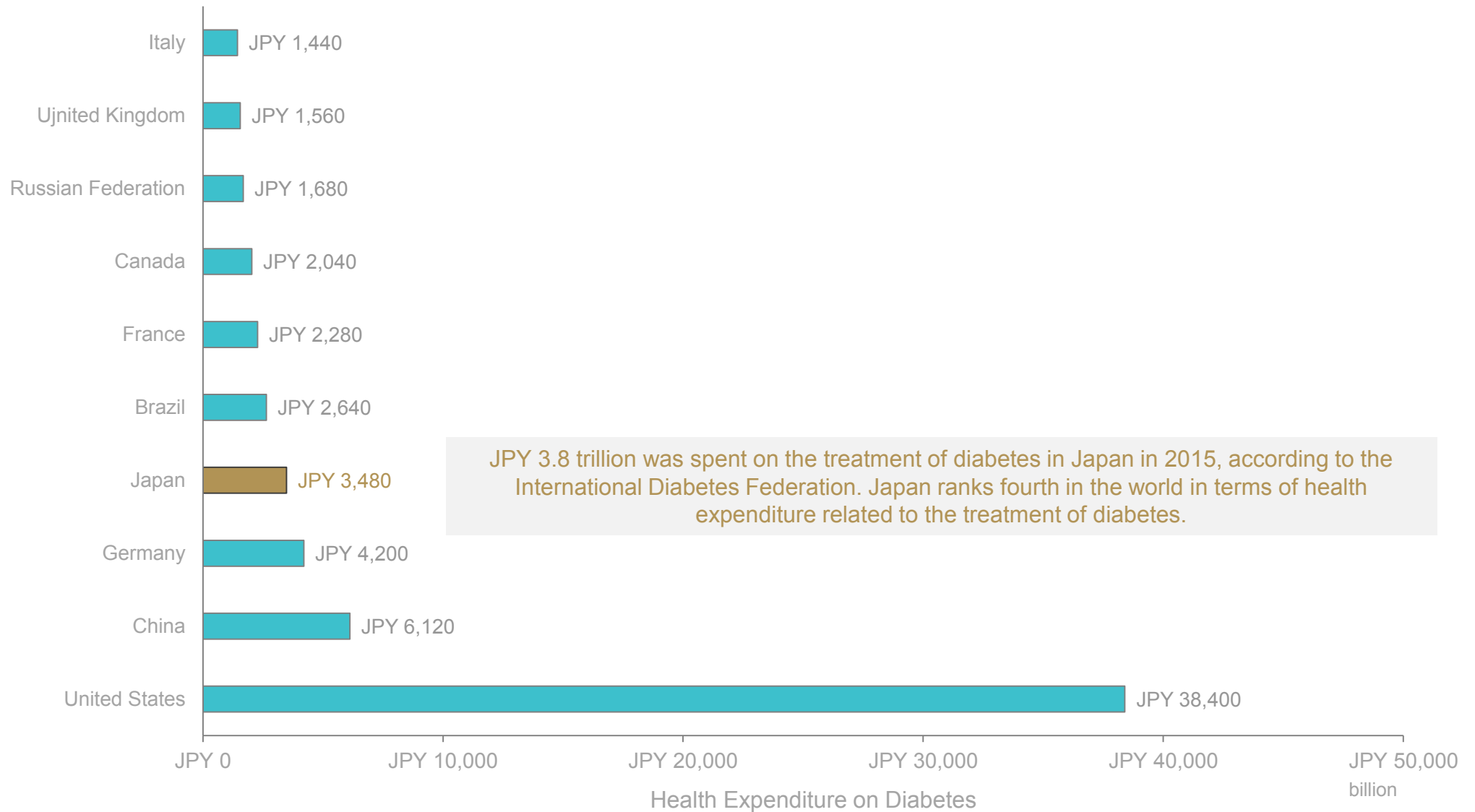
In 2015 there were a total of 7.2 million cases of type 2 diabetes

These societal conditions put the public services and workforces under significant strain, which has substantial societal costs associated.

The socio-economic impacts of these conditions are detailed over the next 5 slides.

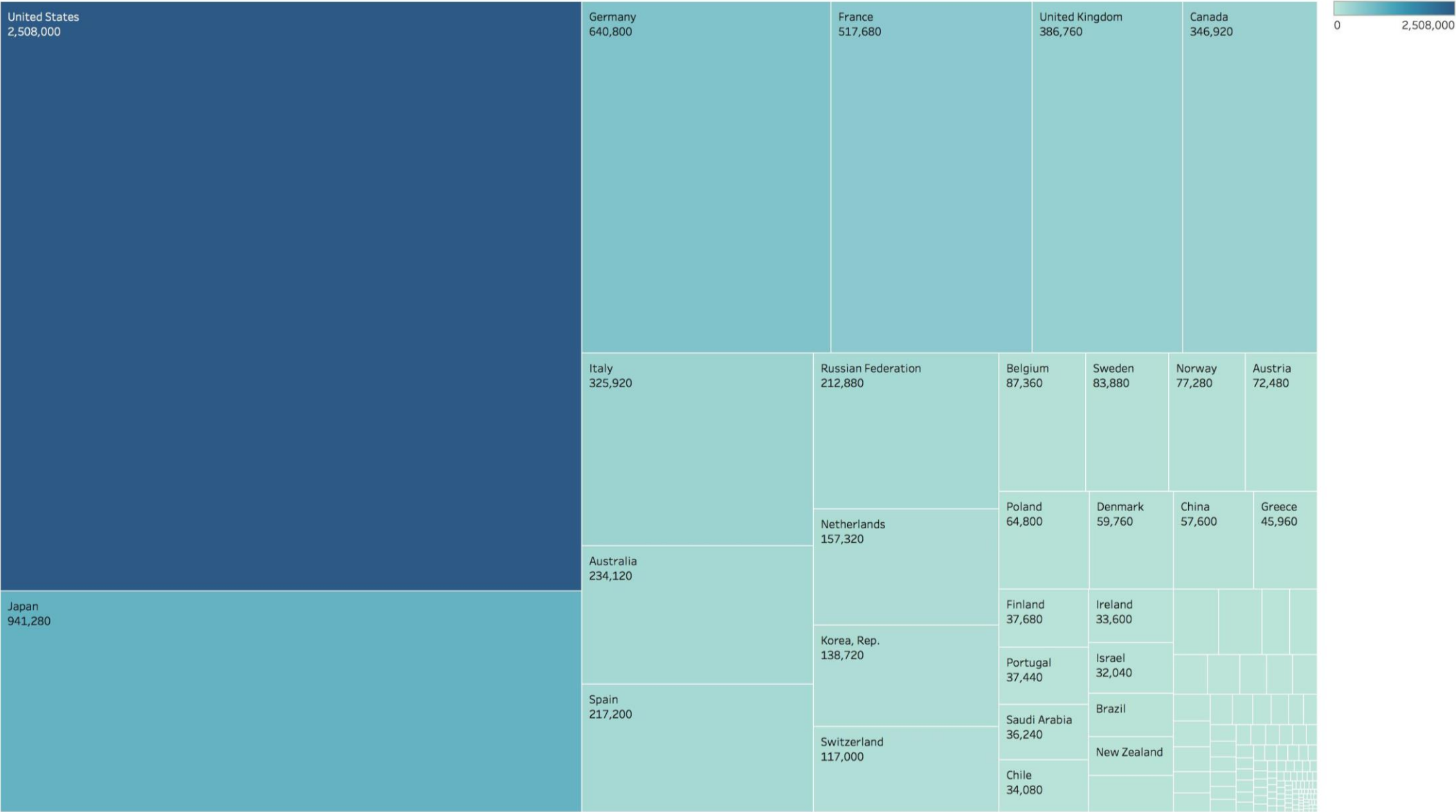
# Impact

## Diabetes Health Expenditure: 'The Top Ten' Country Comparison (2015)



# Impact

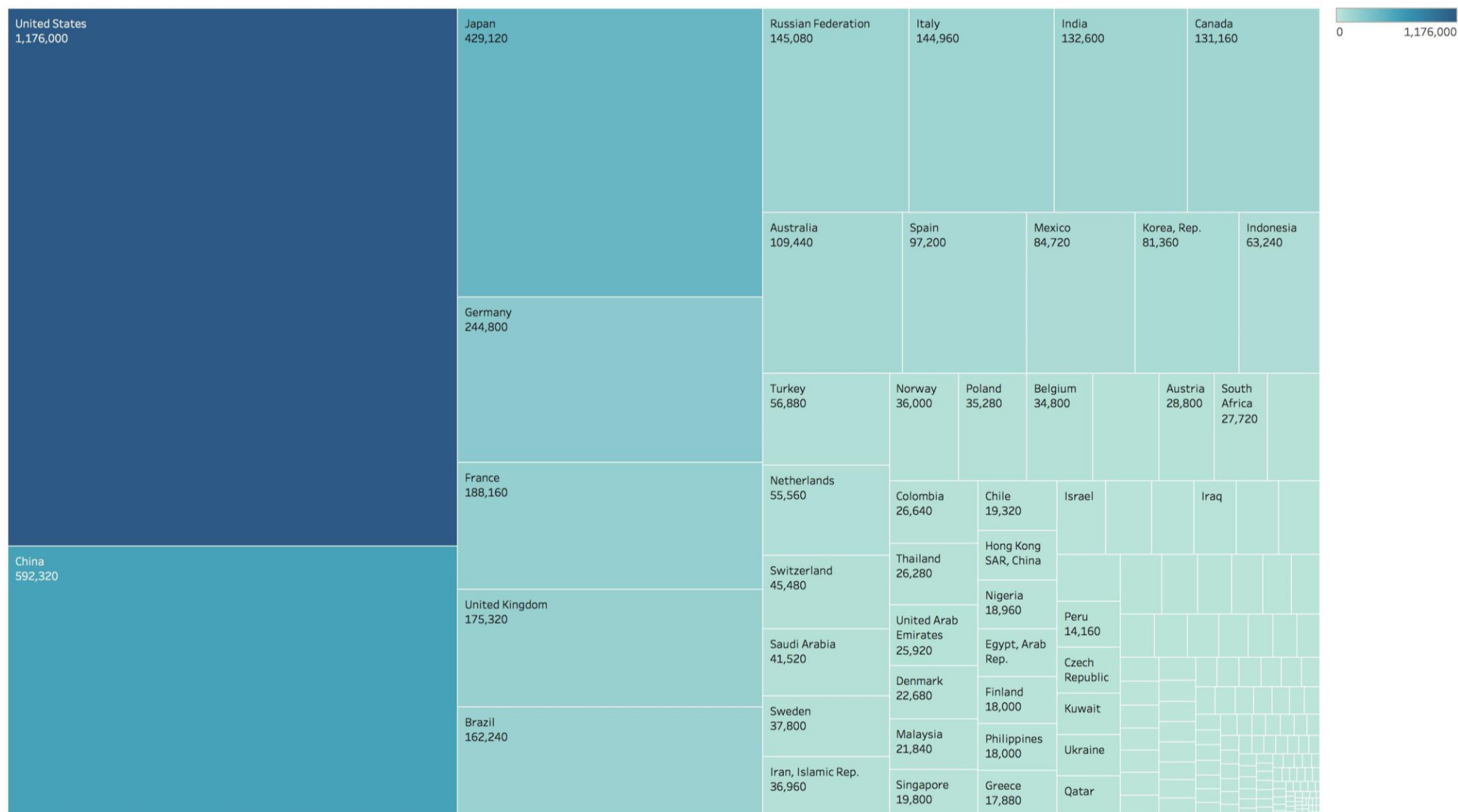
## Direct Costs of Heart Failure (JPY million)



Country name and sum of Direct cost of Heart Failure (JPY million). Color shows sum of Direct cost of Heart Failure (JPY million). Size shows sum of Direct cost of Heart Failure (JPY million). The marks are labeled by Country name and sum of Direct cost of Heart Failure (JPY million).

# Impact

## Indirect Costs of Heart Failure (JPY million)



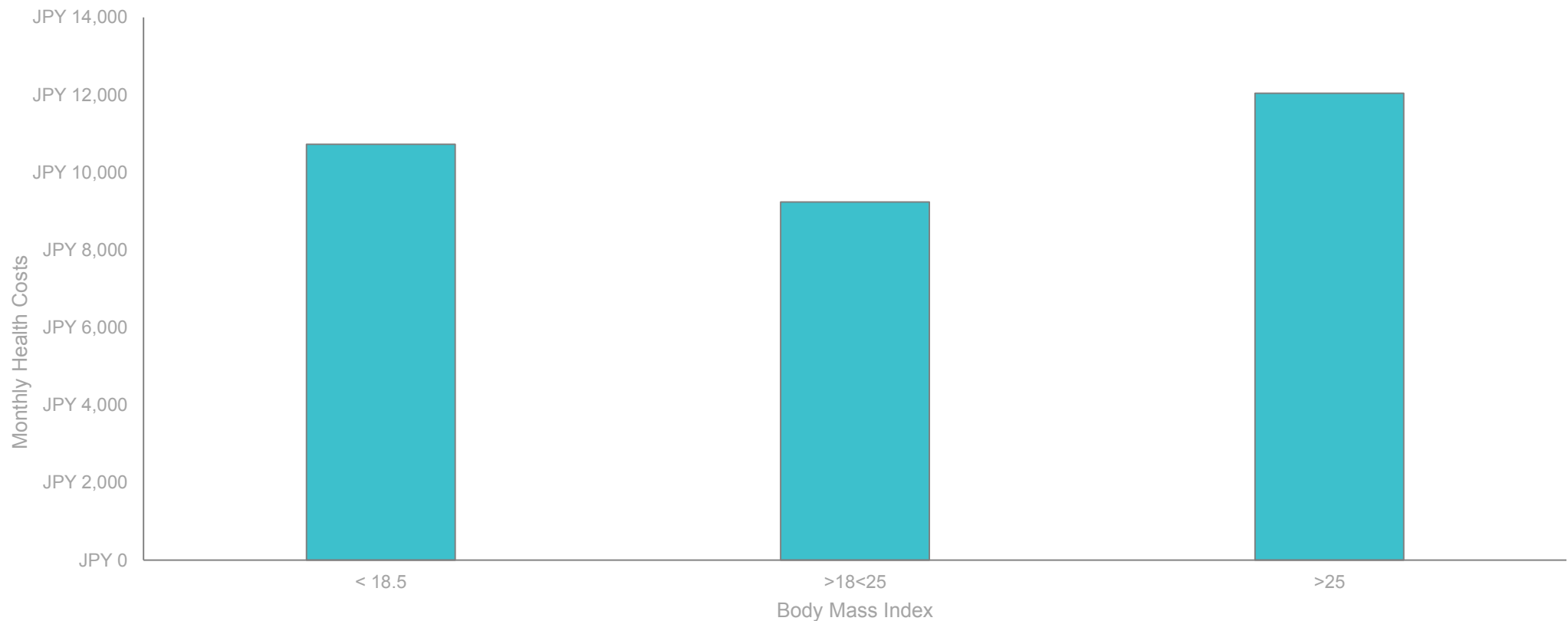
Country name and sum of Indirect cost of Heart Failure (JPY (million)). Color shows sum of Indirect cost of Heart Failure (JPY (million)). Size shows sum of Indirect cost of Heart Failure (JPY (million)). The marks are labeled by Country name and sum of Indirect cost of Heart Failure (JPY (million)).

# Impact

## Obesity

For the Japanese population a Body Mass Index (BMI) of 25-29.9 is classified as obese and presents a greater risk profile for cardiovascular disorders such as hypertension. Nakamura et al., (2007) measured the excess medical costs per person per month over a ten year period adjusting for factors such as smoking, age, sex, and drinking habits. The estimated excess medical costs for the less than 25 BMI population category represented only 3.1% of the total medical costs for the entire study population.

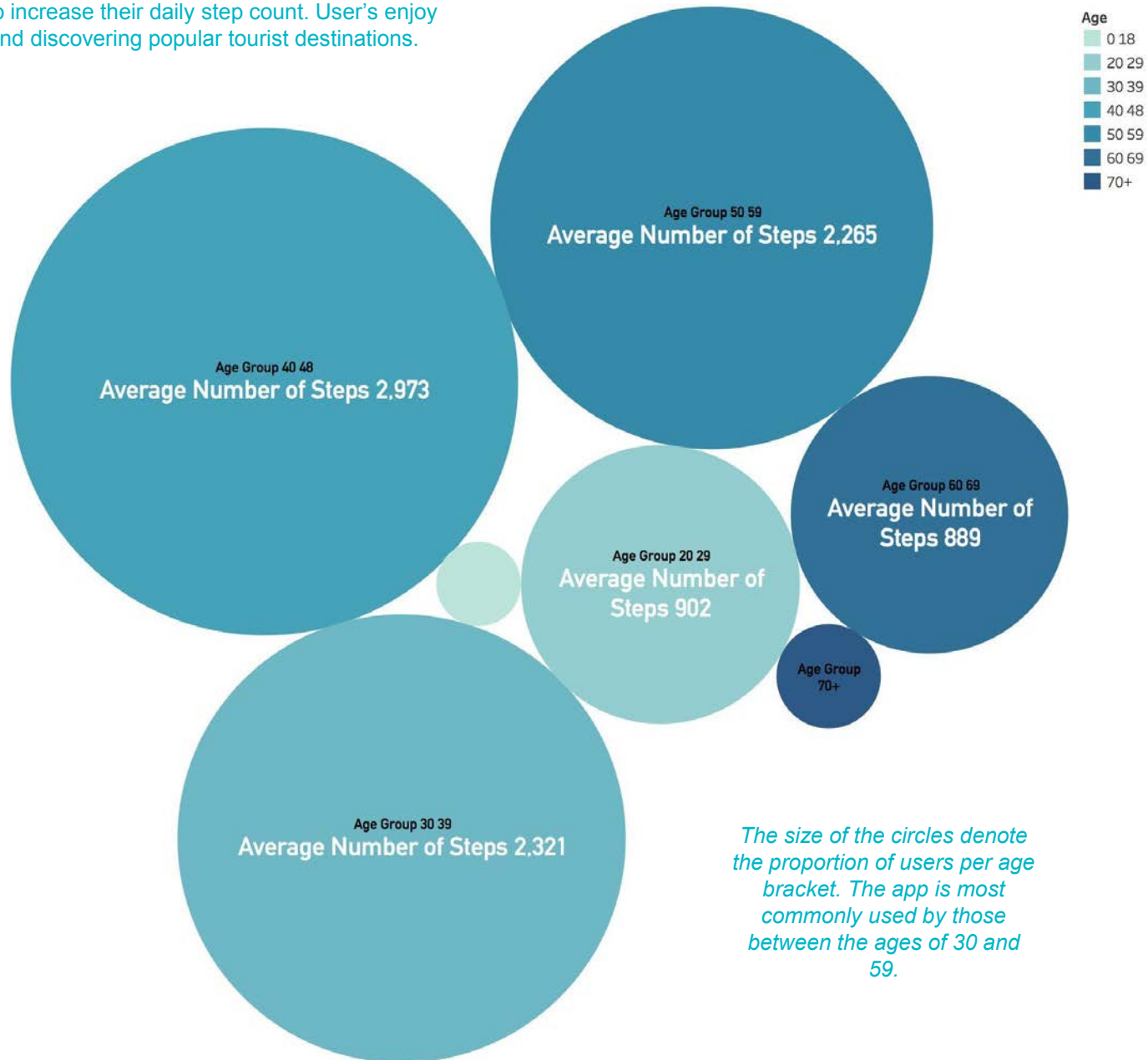
Monthly Healthcare Costs by Body Mass Index



# Response

## Aruite Otoku: Age of Users and Average Number of Daily Steps per Age Bracket

Aruite Otoku encourages users to increase their daily step count. User's enjoy receiving D points for walking and discovering popular tourist destinations.

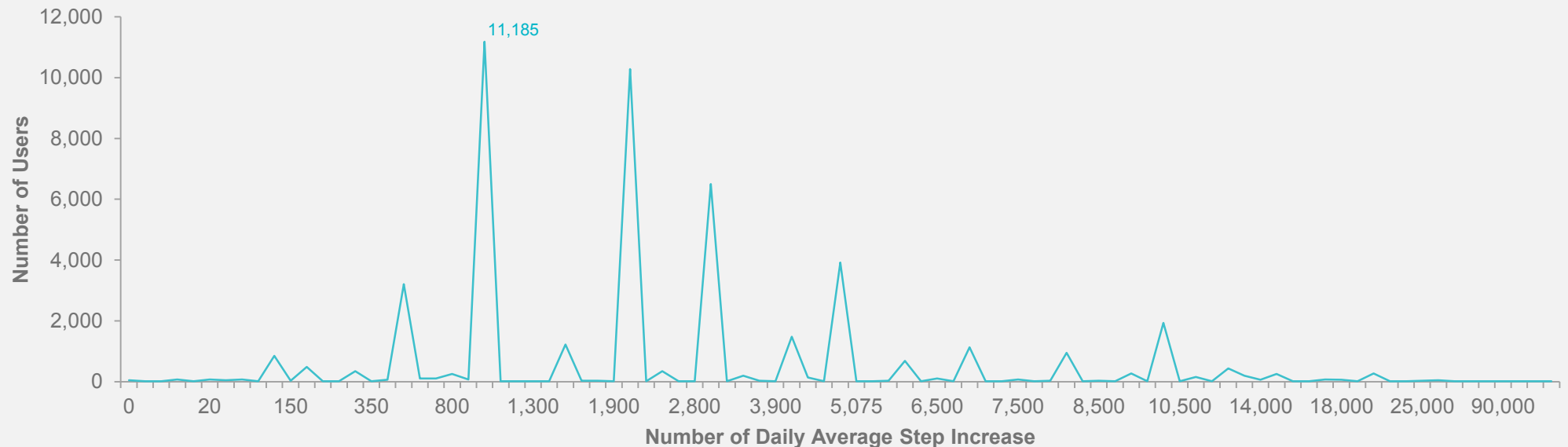




# Response

## Aruite Otoku: Treatment of Data

- NTT Docomo reported figures for the daily number of steps taken and the daily step increase from survey respondents
- For the purposes of this analysis it is necessary to use the data of the daily step increase because the increase implies a change in behavior, which is what's necessary to alleviate symptoms of diseases and ailments (and their associated costs). It represents the 'pressure' and subsequent change in state.
- The survey data provided had outliers that have since been excluded from the analysis. For example, daily step increases of over 30,000 were reported, all the way up to 300,000 steps. Calculations suggest such step rate equates to walking distances of between 8 and 77 hours in a 24 hour day. These figures range from difficult to impossible to achieve.
- Reported step increases were eliminated using the following approach; Steps count was eliminated if the reported count exceeded the average amount of spare time in a day equal to [442] minutes, as calculated by the total minutes in a day (1440) less the average number of minutes worked (528) and less the average number of minutes of sleep (470). The nearest cut off in the dataset is 25,000 steps (385 minutes). These calculations were made using a rate of 65 steps per minute.



# Response

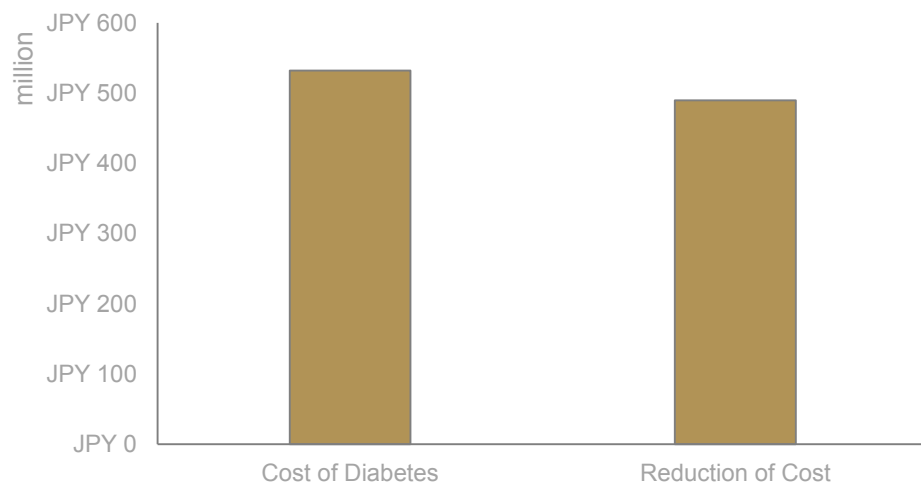
## Aruite Otoku

- A total of 48,653 users are reported of which 151 were classed as outliers and a further 29,156 did not achieve a daily step increase 'threshold' of 3000 steps (as the research suggests that a minimum of 3,000 steps is required to lead to a reduction in health costs associated with Diabetes, Ischemic Heart Disease, and Obesity). This leaves a total of **19,346 users** who are included in the socio-economic assessment and evaluation of the mobile application's health benefits.
- Prevalence rates of the aforementioned diseases were used to estimate the likely number of cases:
  - Diabetes is estimated to afflict **5,688 per 100,000 people** in Japan;
  - Ischemic heart disease is estimated to afflict **35.4 per 100,000 people** in Japan;
  - Obesity is estimated to afflict **28.8 per 100,000 males & 18.8 per 100,000 females**
    - Note, suicide from depression was excluded from the analysis as the evidence uncovered proved to be inconclusive
- Using these prevalence rates, it is estimated that **[2,768]** Aruite Otoku users are diabetic, **[17]** are at risk of heart failure and **[12]** have a BMI over 25.
- The annual cost of these diseases and ailments equals **JPY 1.3 billion, JPY 525 million and JPY 199 million** respectively.
- Kato et al, (2013) evaluated the effect of walking on medical costs by simulation. Focusing on the Japanese population, they include estimates of an 8.4% reduction in health costs if participants walk a minimum daily increase of 3,000 steps for conditions such as diabetes and heart disease. This study assumes the same factor can be extended to obesity.
- NTT Docomo's provision of the mobile application has increased the daily step count of 19,346 people above the 3,000 steps threshold and this analysis suggests that assuming the users continue to engage in sustained physical activity the annual health costs of the users can be expected to decline at the rate outlined in Kato's study.
- The results of this reduction in cost are shown overleaf.

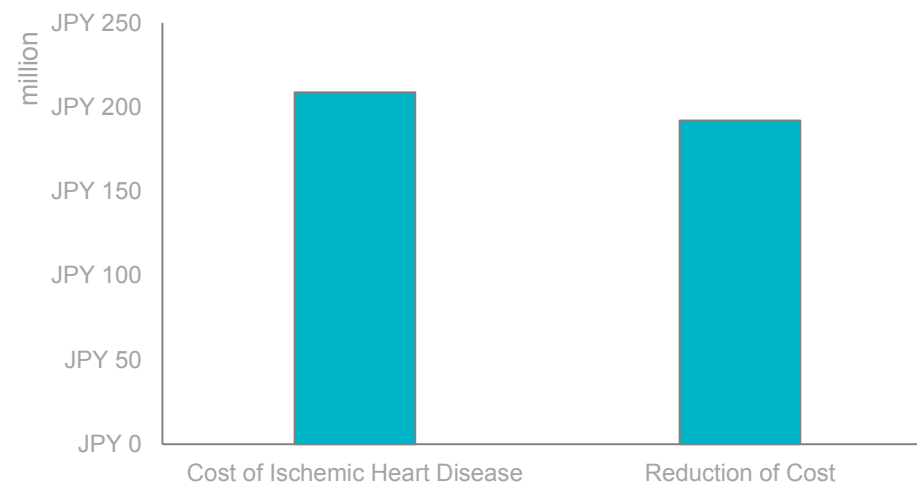
# Response

## Aruite Otoku

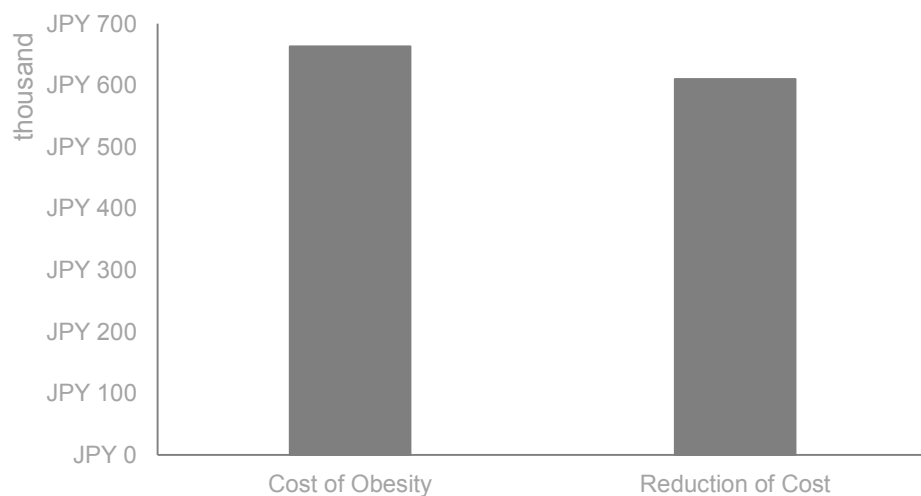
Cost of Diabetes & Cost Reduction



Cost of Heart Disease & Cost Reduction



Cost of Obesity & Cost Reduction



Using the prevalence rates of each of these diseases and ailments, and removing outliers from the Aruite Otoku data and all users reporting less than 3,000 steps, it is estimated that 1,100 of the users will have diabetes, 7 are at risk of heart failure and 5 suffer from obesity. The total costs associated with these cases are shown in the adjacent graphs and amount to a social cost of JPY 741,351,326. By increasing their daily step count by a minimum of 3,000 it is estimated that the cost of these diseases will reduce by 8.4 per cent

In other words, through encouraging users to walk more NTT Docomo is reducing the burden disease on society.

This equates to a social benefit in the year 2016 of JPY 59 million

# Summary

## The Socio-Economic Benefits of the Mobile Application

- The maintenance and improvement of the state of the nation's health and well being extend beyond the remit of the government.
- It is increasingly accepted that individuals and corporates must also take responsibility.
- NTT Docomo provides a mobile application that incentivizes people to do more physical activity thus improving the state of the health and wellbeing of the population.
- Physical activity, in this case walking, can reduce the costs associated with diabetes, heart failure and obesity – as individuals become healthier they rely less and less on the societal funded health care system.
- It is estimated that Aruite Otoku is responsible for reducing the healthcare costs of 1,112 users who were statistically at risk of either having diabetes, heart failure or obesity.
- This analysis finds that the reduction in cost attributed to the increase in steps should be considered as a societal benefit of NTT Docomo and representative of one dimension of their **Value To Japanese Society**.
- The social benefit of **Aruite Otoku** related to just three diseases equates to **JPY 59 million**

# Limitations

## 1. The study lacks substantial depth

- This study only considers 3 diseases and does not explicitly consider user lifestyles. This study falls very short of a rigorous medical and subsequent economic analysis of the benefits of increased walking, however considering the very modest decreases in associated cost (through understood improved health through exercise and specifically walking), the presented directions and magnitudes of avoided costs are fit for purpose.

## 2. There is no granular estimate or assessment of the indirect costs

- This study only considers the direct health care costs and part indirect costs for Ischemic heart disease. Further research should consider the indirect benefits associated with increased walking such as reduction in depressive symptoms.