

**GCC-Stat & UNSD**  
**Workshop On the**  
**Principles and Recommendations for a Vital Statistics System, Revision 3, For**  
**Arabic Speaking Countries**  
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# **Assessing Completeness and Quality of death registration in the Death Notification System in Oman**

**Using Direct methods (Capture Recapture) and Medical  
Records Review**

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# Outline

- Introduction
- Methods and processes
- Results & Key Findings
- Strengths
- Limitations of the study

# Introduction: Overview of Oman

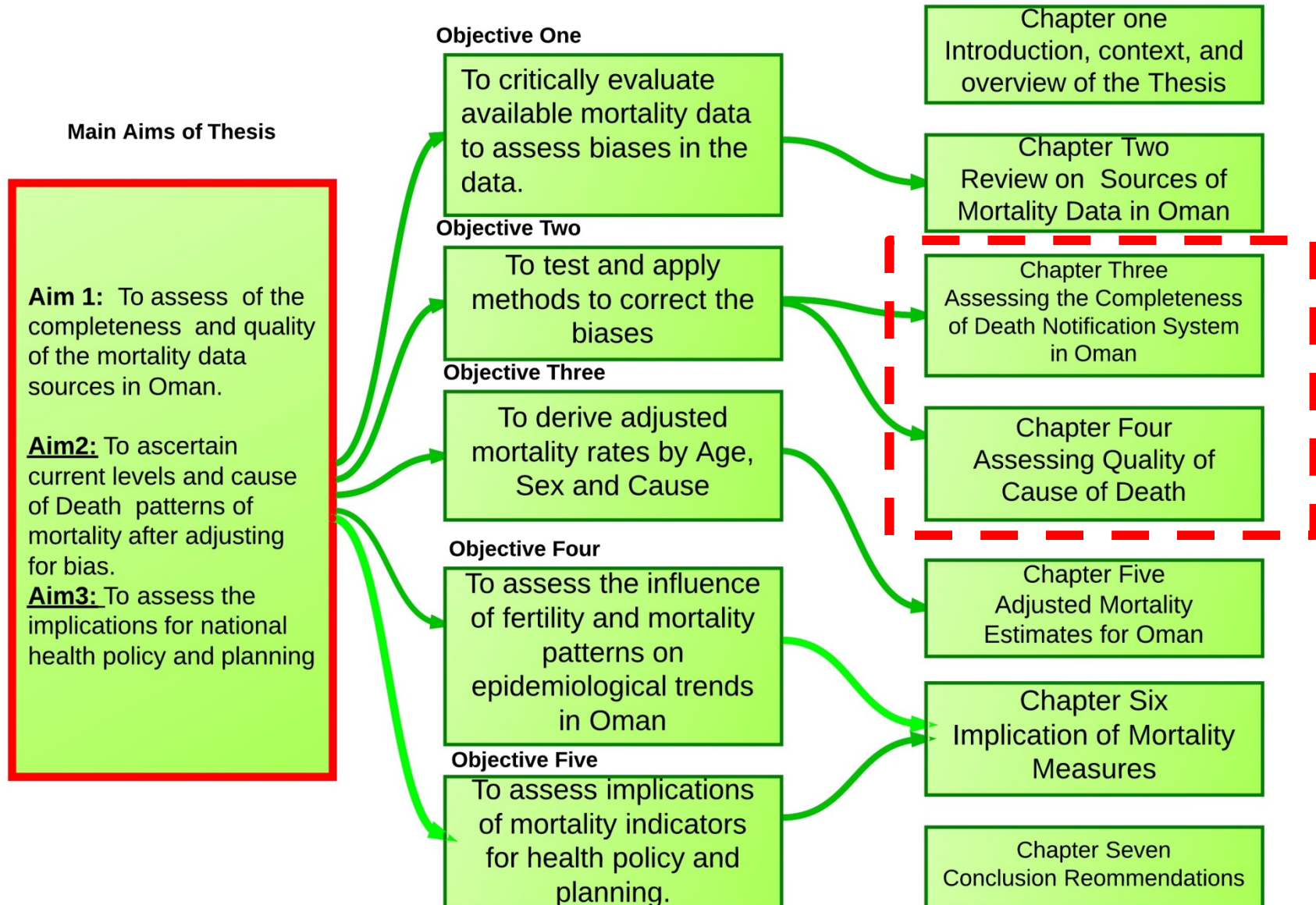
- Population is about 4.5 millions; of whom 55% are Omanis (45% Expatriates)
- Rapid Economic Growth from 1970 along with population growth
- Variation of Population density (from <1 to 350) per sq km



# Introduction: Death registration in Oman

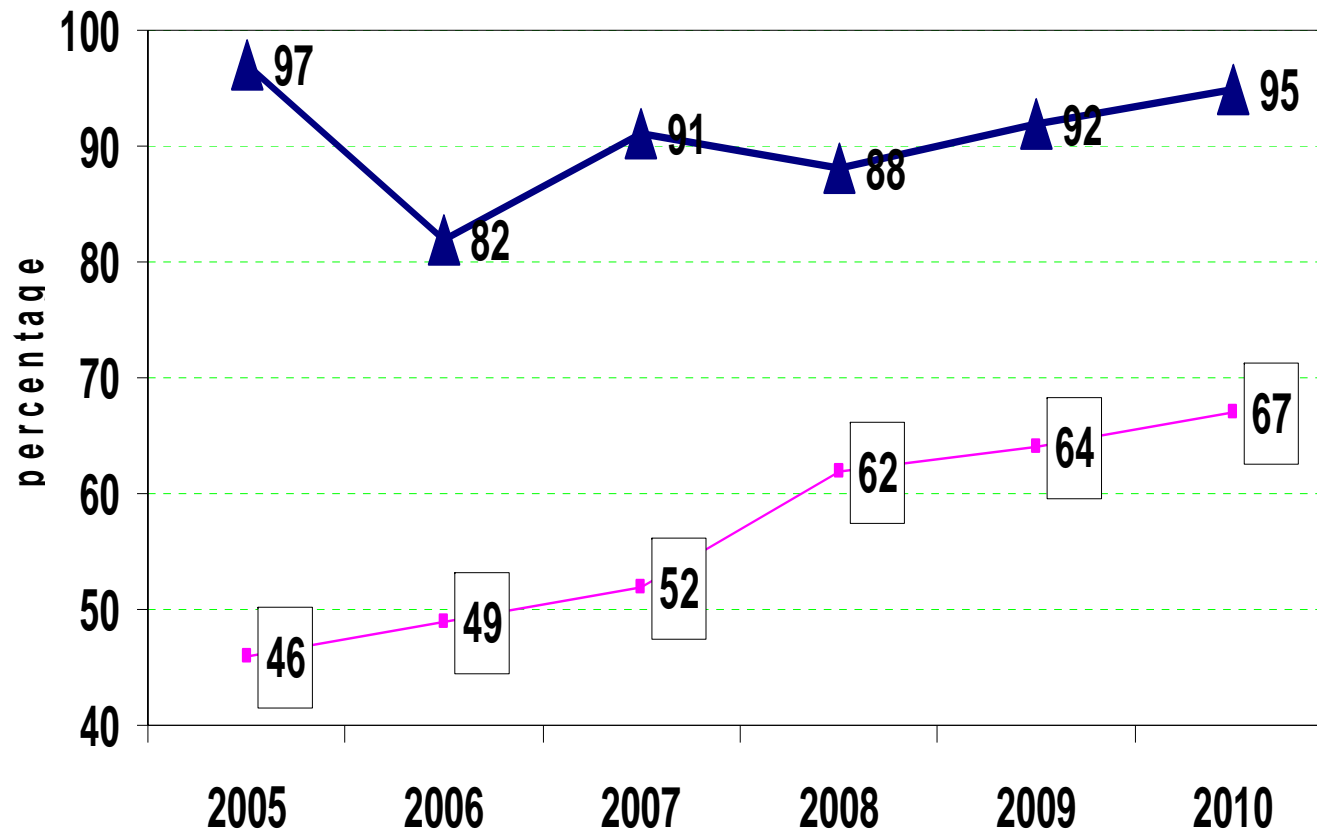
- **First Census was carried in 1993 followed by two censuses 2003 and 2010**
- **Mortality module were included in the censuses**
- **Death notification system introduced in 2004 as part of civil registration system.**
- **Some secondary sources of death data including medical records at health facilities, and demographic health surveys.**
- **These are valuable resources for verifying the validity of the mortality data collected by the death notification system.**

# PhD on : Mortality Patterns in Oman (Demographic and Epidemiological Review)



# (A) Assessing Death Registration Completeness

# Indirect Techniques Death Completeness of Death Reporting



► Assumptions

- (1) Closed population
- (2) Stable population
- (3) Misreporting of deaths is constant across the age groups

No. of Deaths

▲ Brass growth balance ■ Preston-Coale

# Why Using capture-recapture for assessing the Completeness of Death Registration

- It has a simple and straightforward logical basis
- The possibility of estimating registration completeness among infants and young children (which is not possible from the indirect methods) is one of the strongest advantages of the method.
- Linkage of two sources of data include the potential to correct specific variables, as well as the potential to complement, merge or integrate other variables of interest into the analysis.
- Capture-recapture can be used to identify deceased's characteristics related to probability of capture by either sources. Such information could be useful for improvement of an ongoing register by identifying subgroups (geographic, age or sex) with a high probability of being missed by the register.



# Assumptions of the method

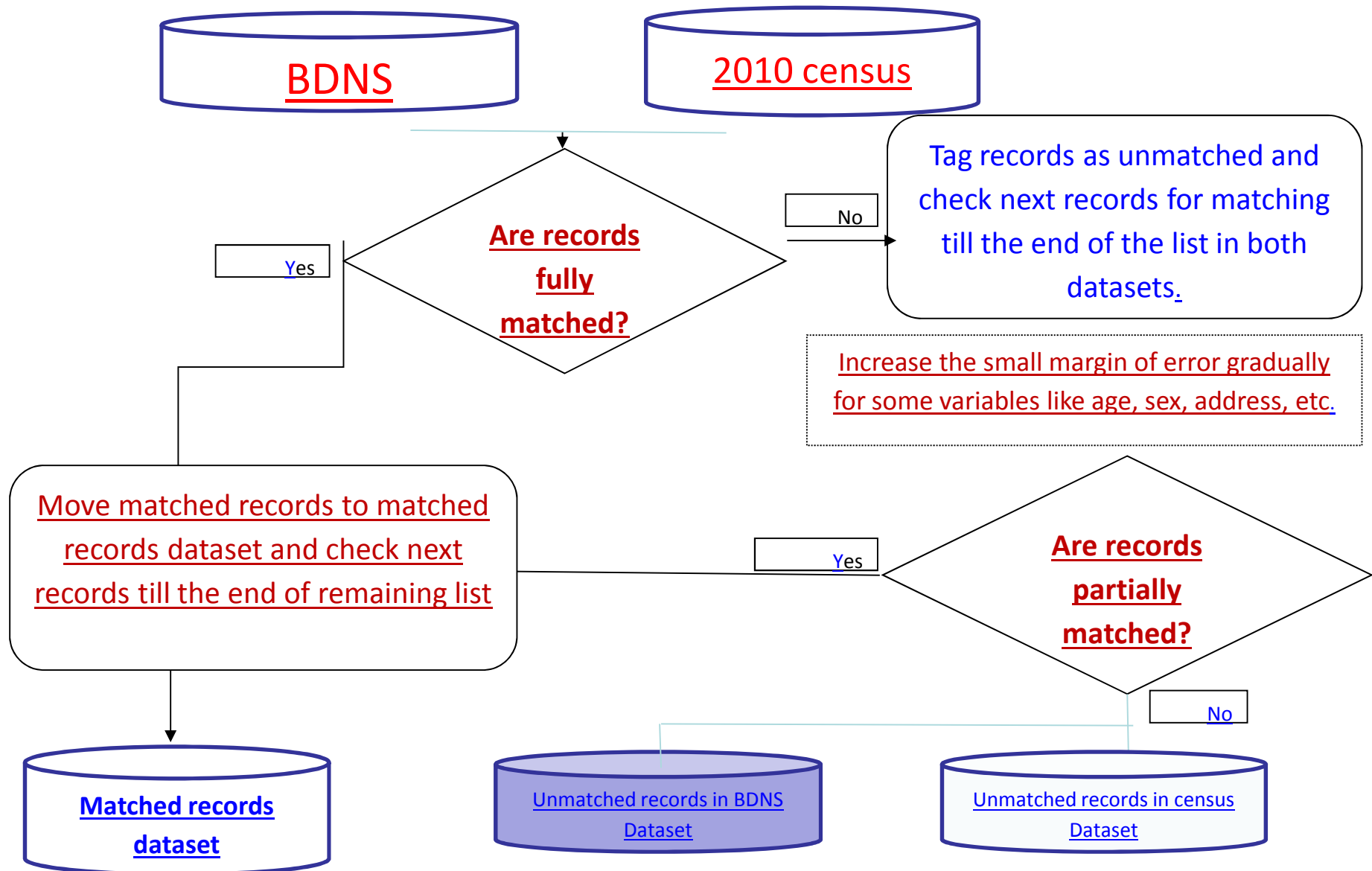
- Independent Sources
- Same time period
- Closed populations
- homogeneity of capture probability

# Birth and Death Notification system (BDNS)

## Mortality module of 2010 Census.

	Census 2010			
		Yes	No	Total
Birth and death notification system	Yes	(M)	(C)	(M+C)
	No	(D)	(X)	
	Total	(M+D)		(N)

# Study Procedures



# Study Procedures

## Define the matching variables

Variable	BDNS database	Census 2010 database
Notification number	√	
Reported institution	√	
Name of deceased	√	
Name/tribe name of applicant*	√	√
Governorate/region	√	√
Wilayat (district)	√	√
Town/village	√	√
Locality or compound		√
Sex	√	√
Date of death	√	√
Age at death	√	√
Date of birth	√	

# Study Procedures

## Initial data quality assessment

Items	Birth and death notification system database	Census
Total records	6,039	5,400
Missing date of death	0	0 <sup>^</sup>
Duplicates	3	19
Missing age	652	0
Missing sex	18	0
Missing governorate	457	0
Missing Wilayat	535	0
Missing nationality	18	0
Missing Wilayat and governorate	457	0
<b>Records used in matching</b>	<b>6,036</b>	<b>5,381</b>

# Study Procedures

## Matching process: Phase One (Exact Matching)

	Number of records
Matched records in the first round	568 (9.5%)
Not matched from birth and death notification system database	5468
Missing age	500
Missing governorate	435
Missing wilayat	502
Missing village/locality	1022

- Missing Values
- Frequent spelling mistakes
- Small differences in the age at death, or in the date of death
- Small difference in the sex of some neonates deaths.

# Study Procedures

## Matching process: Phase Two 49.5%

Based on the observations from phase one, it was decided to first apply the following generic criteria to the existing dataset, and repeat matching exercise.

1. A band of 5 years was applied to the age at death for Adults (i.e. differences in age of up to 5 years for a record which is matched on all other variables was considered a match).
2. A variation of one month in the date of death for records matched on all other variables was considered a match.
3. Spellings of village names in both the birth and death notification system database and the census datasets were corrected to ensure uniformity.
4. Cases of neonatal deaths that were matched on all other variables besides gender were considered a match.

# Study Procedures

## Matching process: Phase Three

Based on the observations from phases one and two :

1. **521 records** (with missing key variables) were returned to the notifying health institutions in order to obtain updated information on the missing variables.
2. **Tribe name** was used to infer the *wilayat/village* of residence (tribe names can be mapped on to known *wilayat/villages*).
3. **Health Institution** was used to infer the missing address variable for the deceased.



# Study Procedures

## Matching process: Phase Three

Based on the observations from phases one and two :

When the age of the deceased was missing, one of several strategies was employed.

1. **Occupation** of the deceased was 'student', the age was inferred to be between 5 and 19 years.
2. **Name** was recorded as 'son of \_\_\_\_\_', 'daughter of \_\_\_\_\_', or even 'baby of \_\_\_\_\_', this was taken as an indication that the deceased was an infant, given the Omani custom of naming only a few weeks following birth.
3. **Cause of death** was used to fix the age (e.g. if the cause was 'birth asphyxia' or 'congenital anomaly', the age was presumed to be that of an infant. If the cause was 'senility' or 'dementia', the deceased was presumed to be from an older age group).

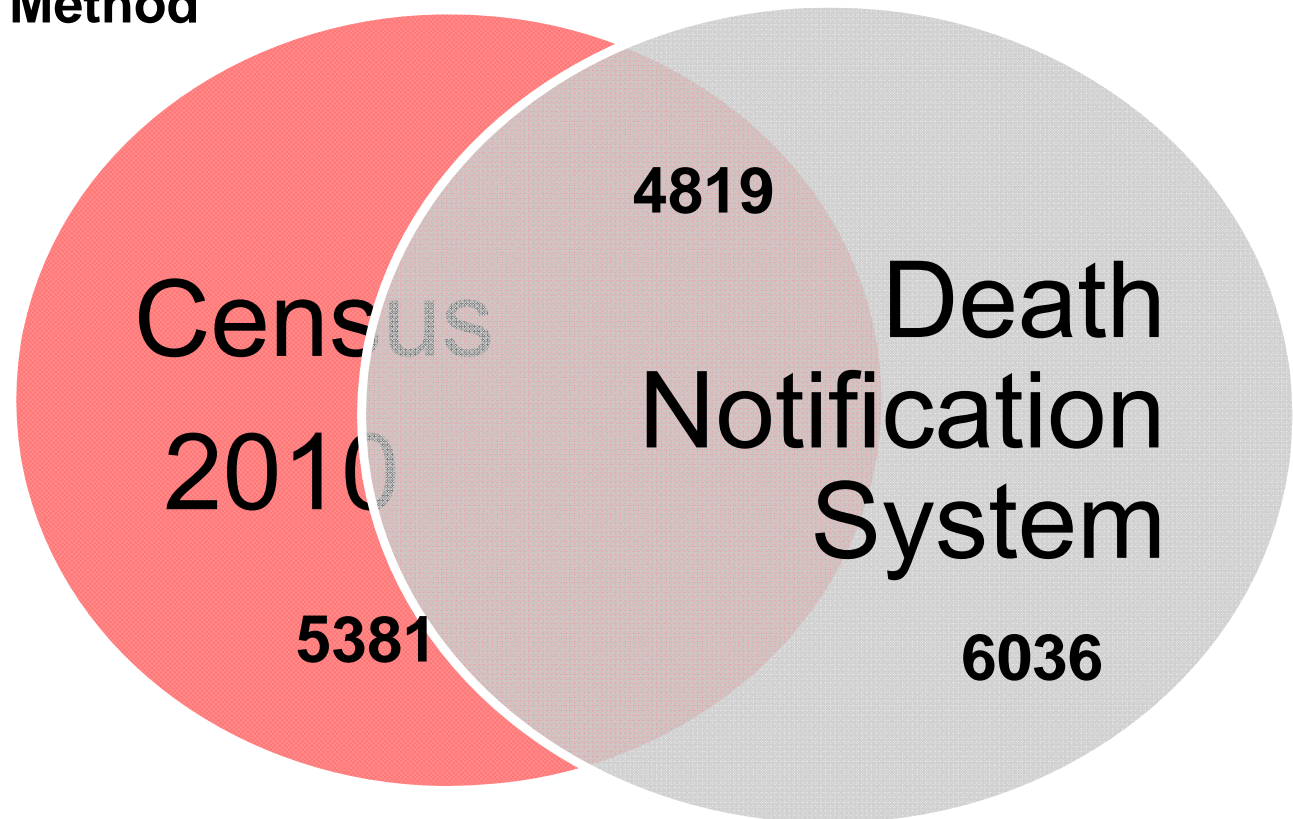
# Study Procedures

## Matching process: Phase Three

	Number of records
Matched records in first, second and third	4,819 (79%)
Not matched	1,217
Reasons for un-matched records*	
Missing age	192
Missing governorate	163 + 5 (residing abroad)
Missing wilayat/village	179
Under-recorded events in census	650

# Results

## Capture-Recapture Method



Census 2010	Matched Records	Death Notification system
5381	4819	6036

# Results

Sex / Age Group	Total records Census	Total records in B&D	Matched Records	Found in BD but not found in census	Found in census but not found in BD	Estimated missing in both	Estimated deaths
<b>Males</b>							
0 - 4	475	369	322	47	153	22	544
5-14	137	83	79	4	58	3	144
15-24	278	252	248	4	30	0	282
25-44	364	388	334	54	30	5	423
45-64	686	794	675	119	11	2	807
65-84	963	1385	948	437	15	7	1407
85+	335	331	306	25	29	2	362
<b>Grand Total</b>	<b>3238</b>	<b>3628</b>	<b>2912</b>	<b>716</b>	<b>326</b>	<b>80</b>	<b>4034</b>
<b>Females</b>							
0 - 4	341	296	248	48	93	18	407
5-14	94	60	60	0	34	0	94
15-24	92	83	79	4	13	1	97
25-44	162	155	148	7	14	1	170
45-64	399	442	379	63	20	3	465
65-84	728	982	699	283	29	12	1023
85+	327	314	294	20	33	2	349
<b>Grand Total</b>	<b>2143</b>	<b>2408</b>	<b>1907</b>	<b>501</b>	<b>236</b>	<b>62</b>	<b>2706</b>

# Death Registration completeness Rates Broad Age Groups

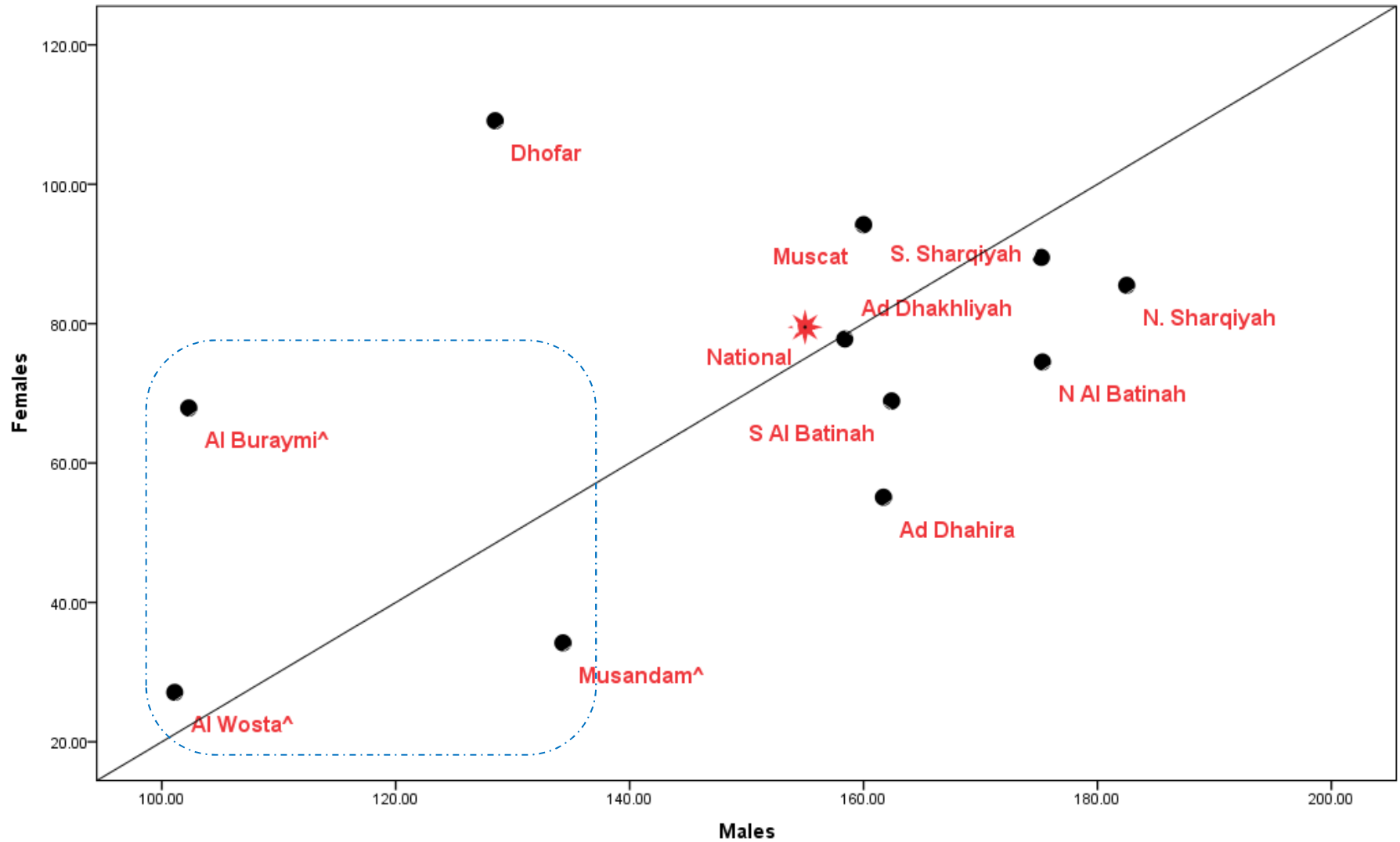
<b>Age Group</b>	<b>Males (%)</b>	<b>Females (%)</b>
<b>0 - 4</b>	<b>68</b>	<b>73</b>
<b>5-14</b>	<b>58</b>	<b>71</b>
<b>15-24</b>	<b>89</b>	<b>85</b>
<b>25-44</b>	<b>92</b>	<b>91</b>
<b>45-64</b>	<b>98</b>	<b>95</b>
<b>65-84</b>	<b>98</b>	<b>96</b>
<b>85+</b>	<b>91</b>	<b>90</b>
<b>Grand Total</b>	<b>90</b>	<b>89</b>

# Life Expectancy at birth and adult mortality By Sex based on Raw Death notification and Adjusted deaths

	Raw Death Data		Study Findings		Global Burden of disease study2010 (IHME)		World health Organization (WHO)		World Bank	
	M	F	M	F	M	F	M	F	M	F
a) Life expectancy at birth	75.2	81.9	73.4	79.7	73.8	78.9	70	76	74	78
c) The adult mortality rate, 15 and 60 years (per 1,000)	150	77	157	82	139	86	157	78	122	76
c) Under five mortality rate	13.4	11.6	21.3	17.3	11.1		12		11.9	10.7
b) Life expectancy at age 60	22	26	21	24	NA		15	19	NA	NA

# Adult Mortality variation among governorates

Male and Female Adult Mortality composition (per 1000 population 15-60 years ) by Governorate - Oman, 2010



## (B) Assessing Data on Quality (Cause of Death)



# Number of medical records reviewed and Death Notifications for leading causes of Deaths in Oman, 2010

MTL	Death notification system	94	NC	52	96	68	67	12	92	66	69	93	77	74	86	61	Other causes	T
	94III-defined conditions	308	5	69	100	79	168	11	6	18	107	14	11	14	19	32	226	1187
	No Causes Specified	71	3	23	77	29	68	3	33	7	47	25	8	11	19	16	127	567
	52Diabetes mellitus	13		99	12	14	44	8		7	55		5	8	9	4	93	371
	96Transport accidents			10	261	7	11	1		1	12		1	2	3	3	21	333
	68Other heart diseases	43		15	11	51	66		3	3	33	9	7	5	8	3	68	325
	67Ischaemic heart diseases	8		12	7	18	93	3		1	26		7	6	6	1	38	226
	12Septicaemia	4		13	6	8	15	9	3	2	33	2	8	26	15	3	62	209
	92Perinatal conditions	3	1	3	3	3	8	2	105		10	28	2	1	1	3	18	191
	66Hypertensive diseases	7	1	8	2	14	34	3		7	44			6	13	3	36	178
	69Cerebrovascular diseases	8		7	6	7	15			1	77		3	10	3	3	29	169
	93Congenital malformations	6		1	3	7	3	4	16	1	4	82	1	1	1	1	17	148
	77Other respiratory system diseases	3		2	4	16	9	3	4	2	15		18	13	3	2	30	124
	74Pneumonia	1		5	3	4	6	3	2	5	16	1	12	34		3	25	120
	86Other genitourinary diseases	3	1	8	2	5	10	2		2	8		5	12	17	1	28	104
	61Other nervous system diseases	3		1	1		5	1	1		9	1	1	1	2	8	25	59
	Other causes	30	0	49	51	42	90	9	3	6	70	7	19	22	15	6	579	998
	<b>Grand Total</b>	<b>511</b>	<b>11</b>	<b>325</b>	<b>549</b>	<b>304</b>	<b>645</b>	<b>62</b>	<b>176</b>	<b>63</b>	<b>566</b>	<b>169</b>	<b>108</b>	<b>172</b>	<b>134</b>	<b>92</b>	<b>1422</b>	<b>5309</b>
	<b>Agreement rate (%)</b>	<b>60%</b>	<b>27%</b>	<b>30%</b>	<b>48%</b>	<b>17%</b>	<b>14%</b>	<b>15%</b>	<b>60%</b>	<b>11%</b>	<b>14%</b>	<b>49%</b>	<b>17%</b>	<b>20%</b>	<b>13%</b>	<b>7%</b>		

# Validation characteristics for Deaths in Oman, 2010

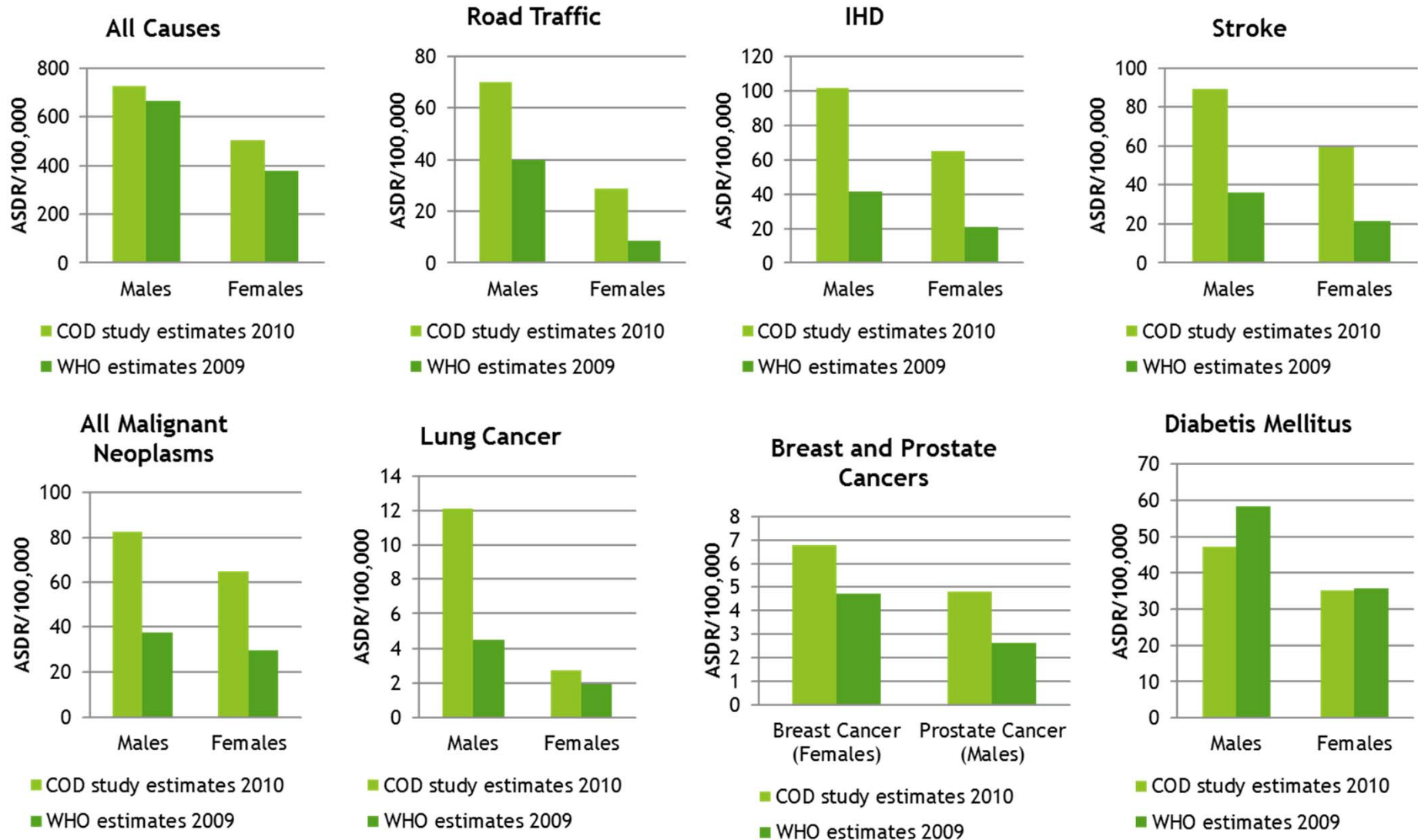
		Cause	As in DNS*	Medical Records review				Sensitivity (95%CI)	Positive Predictive value (95% CI)	Change in CSMF (%)
				Matched	Assigned to other Causes	Assigned from Other causes	Final			
1	94	Symptoms and ill-defined conditions	1187	308	879	203	511	60.3 (57, 63)	26.0 (23, 28)	-57.0%
2	52	Diabetes mellitus	370	99	271	226	325	30.5 (26, 35)	26.8 (22, 31)	-12.2%
3	96	Transport accidents	333	261	72	288	549	47.5 (42, 53)	78.4 (74, 83)	64.9%
4	68	Other heart diseases	332	51	281	253	304	16.8 (13, 21)	15.4 (11, 19)	-8.4%
5	67	Ischaemic heart diseases	219	93	126	552	645	14.4 (10, 19)	42.5 (36, 49)	194.5%
6	12	Septicaemia	209	12	197	47	59	20.3 (15, 26)	5.7 (3, 9)	-71.8%
6	92	Perinatal conditions	191	105	86	71	176	59.7 (53, 67)	55.0 (48, 62)	-7.9%
7	66	Hypertensive diseases	178	7	171	56	63	11.1 (6, 16)	3.9 (1, 7)	64.6%
8	69	Cerebrovascular diseases	169	77	92	489	566	13.6 (8, 19)	45.6 (38, 53)	234.9%
9	93	Congenital malformations	148	82	66	88	170	48.2 (40, 56)	55.4 (47, 63)	-14.9%
10	77	Other diseases of the respiratory system	124	18	106	90	108	16.7 (10, 23)	15.4 (8, 21)	-12.9%
		All other cases	1282				1822			
		No recorded causes	567				11			
		Grand Total	5309				5309			



# Leading causes of YLL by sex, Oman 2010

Rank	Males		Females	
	Cause of Death (Rank as per L COD)	% of total	Cause of Death (Rank as per L COD)	% of total
1	Transport accidents (1)	21.9	Transport accidents (4)	12.4
2	Congenital malformations (8)	7.7	Congenital malformations (7)	11.9
3	Perinatal conditions (9)	7.4	Perinatal conditions (9)	8.8
4	Ischaemic heart diseases (2)	6.8	Ischaemic heart diseases (1)	7.1
5	Cerebrovascular diseases (3)	5.6	Cerebrovascular diseases (3)	5.9
6	Other heart diseases (5)	3.8	Other diseases of the nervous system (13)	4.2
7	All other external causes (13)	3.2	Diabetes mellitus (5)	3.6
8	Other diseases of the nervous system (12)	3.0	Other heart diseases (6)	3.5
9	Accidental drowning (16)	3.0	Pneumonia (8)	2.6
10	Diabetes mellitus (6)	2.8	Other malignant neoplasms (10)	2.6
11	Pneumonia (7)	2.1	Accidental drowning (24)	2.4
	(All Other causes)	23.5	(All Other causes)	25.7
Total YLL		126351		74945

# Age Standardized cause-specific death rates per 100,000 populations based on COD Study / WHO estimates 2009 Oman 2010



# Key Conclusion

- Greater certainty around cause of death, reduction of misinformation through 'garbage' codes
- Direct methods have greater plausibility for the context of Oman
- Underreporting of death in Oman now estimated around 10%
- Life expectancy estimates more confident, useful for economic and epidemiological analysis
- The main age group for premature mortality of Oman population is in Adulthood (15-60 years).
- The thesis output will have an impact on directing the health policies to adapt strategies and plan to reduce preventable deaths such as Road accidents, Adult mortality

# Strengths

- The Study Covered **all Omani Population**
- It provided completeness rates of death registration across different **age groups, Geographic distribution.**
- Easy to be repeated in future and it can suggest the required changes and interventions needed into mortality module of coming census 2020.
- It has highlighted on the defects of BDNS and suggest the changes required to overcome such incompleteness of reporting or overcome missing fields of the notifications (**enforcement, validation etc.**)

# Limitations

- **Missing data/errors** in some of the key matching variables, such as date of birth and address in the birth and death notification system.
- **Slight differences in some variables**, particularly in the census, (e.g. date of death, date of birth). These differences are probably due to recall bias where the relative is required to recall details of the deceased.
- The **name of the deceased** is missing in the census data set (this has been resolved as described previously in the matching process) although it would be increase the reliability if it included in future.
- It covers **Omani nationality** since the Mortality module in the censuses was only for Omanis.



# Limitations

- Losing of about 10% of reviewed forms of deaths was a challenge.
- Lack of detailed information in medical records for some records.
- Study time frame.

# Recommendations

Recommended operations research activities to improve mortality data quality

- Hospital mortality review committees
- Brought-dead and home deaths:
- Injuries (Road traffic accidents in particular): The quality of causes of death recorded for RTA needs to be enhanced to ensure two critical data needs;
  - Complete information for detailed coding of external causes.
  - Detailed information on body parts injured for coding of internal causes

# Recommendations

## Research to strengthen epidemiology and health policy

- 1- Multiple cause of death analysis
- 2- Data sharing with disease-specific registries
- 3- Health policy and systems research

# Recommendations

In conclusion, this thesis demonstrates the feasibility in utilising vital registration data for estimating mortality in Oman.

The research methods for data collection and analysis have established a benchmark for mortality measurement and estimation, and could be applied periodically over the coming years.

The findings from these mortality estimation activities should be followed up with dissemination activities to inform policy analysts and public health professionals, to ensure their utilisation.

# Recommendations

**Finally, similar research to evaluate data quality and guide data utilisation should be conducted on a periodic basis in other Gulf Cooperation Council states (and potentially other countries in the Middle East region) which share similar health system characteristics, and to enable comparative analysis to address potentially common health problems.**

**The documentation of this research provides a basis for capacity building for such activities, and will help the improvement and utilisation of data on levels of mortality and causes of death across the region in the near future.**

Thank you