NUS National University of Singapore | Yong Loo Lin School of Medicine

Young Heart at Risk

Preliminary Insights into Detection and Personalized Management of Acute Myocardial Infarction(AMI)

Logo of Young Heart

Xiao Luyang

Behavioural and Implementation Science in Healthcare, National Universtiy of Singapore

Feb 05, 2026

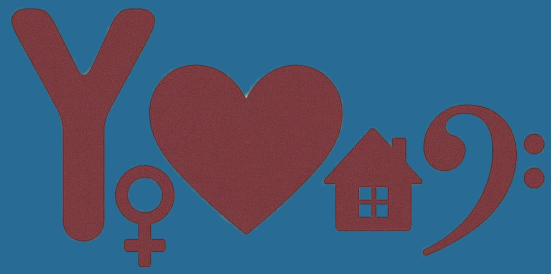
Oceania Stata Conference

Catalogue

NUS National University of Singapore | Yong Loo Lin School of Medicine

PART ONE

Background



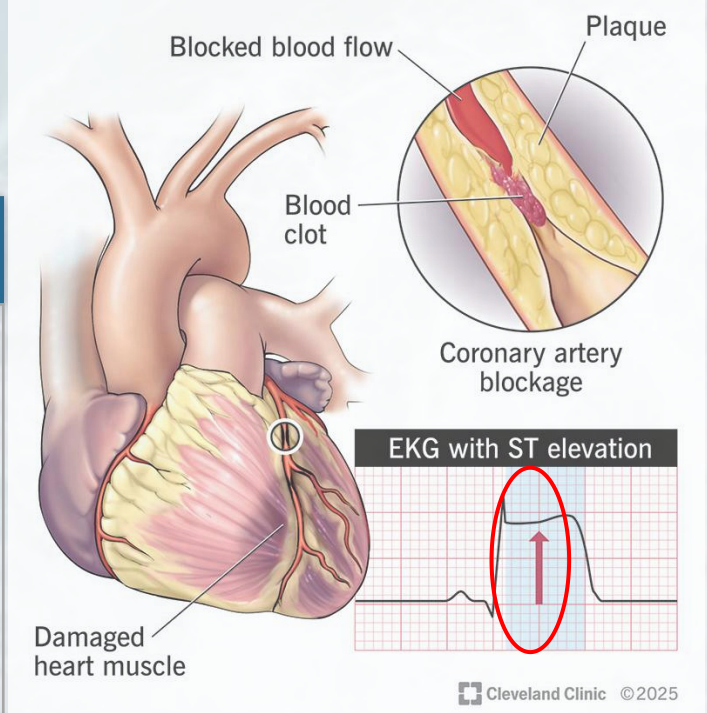
Background

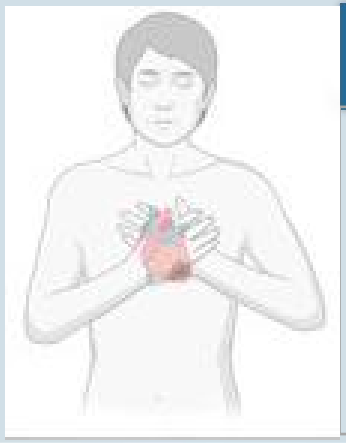
Introduction

Acute Myocardial Infarction(AMI): Coronary Artery blood flow reduces or stops.

ST-segment elevation myocardial infarction(STEMI): abnormal elevation of the ST segment on the electrocardiogram.

Risk factors include **hypertension, smoking, diabetes, lack of exercise, obesity, hypercholesterolemia, and excessive alcohol***(Mehta et al, 2015; Thomas et al, 2018)*.





Rising burden of AMI

AMI's global damage: 8.9 million deaths in 2019 (WHO)

In Singapore: Afflicts 10,000 Singaporeans annually, and the incidence is expected to increase by 59% by 2030 (AMI-HOPE project, NUS).

Young AMI patients in Singapore: 94% are male, mean age of 40.2 years*(Wong et al, 2012)*.

Reference:
Mehta, P. K., Wei, J., & Wenger, N. K. (2015). Ischemic heart disease in women: a focus on risk factors. Trends in cardiovascular medicine, 25(2), 140–151. https://doi.org/10.1016/j.tcm.2014.10.005
Thomas, H., Diamond, J., Vieco, A., Chaudhuri, S., Shinnar, E., Cromer, S., Perel, P., Mensah, G. A., Narula, J., Johnson, C. O., Roth, G. A., & Moran, A. E. (2018). Global Atlas of Cardiovascular Disease 2000-2016: The Path to Prevention and Control. Global heart, 13(3), 143–163. https://doi.org/10.1016/j.gheart.2018.09.511
Wong, C. P., Loh, S. Y., Loh, K. K., Ong, P. J., Foo, D., & Ho, H. H. (2012). Acute myocardial infarction: Clinical features and outcomes in young adults in Singapore. World journal of cardiology, 4(6), 206–210.

Background

Singapore Risident Population

Chinese(74.0%), Malay(13.5%),Indian(9.0%) & Other(3.4%).

AMI in Singapore (2018)

Incidence rate:
Age - ≥65 (1,380cases / 100,000 people); 40~64 (286 / 100,000); 15~39 (11 / 100,000).
Gender - Male (483 / 100,000people, diabetes and smoking); Femal (228 / 100,000, overweight and hyperlipidemia).
Race - Chinese (58 / 100,000), Malays (114 / 100,000), Indians (126 / 100,000).
30d and 1yr mortality rates - Chinese (15% and 21%), Malays (13% and 18%), Indians (9% and 13%)

(Zheng et al, 2019).

AMI Expected Trends in next 25 years

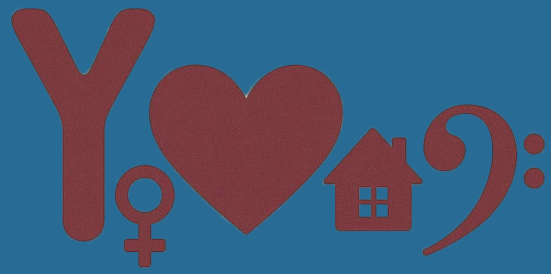
Incidence rate would increase by 194.4%:
Age - ≥65: +28.3%; 40~64: +114.0%; 15~39 +93.2%.
Gender - Male: +211.9%; Female: +169.5%.
Race - Chinese: +202.8% ; Malay: +216.4% ; Indians: +147.4%

(Chew et al. 2023)

Reference:
Zheng, H., Pek, P. P., Ho, A. F., Wah, W., Foo, L. L., Li, J. Q., Utravathy, V., Chua, T. S., Tan, H. C., & Ong, M. E. (2019). Ethnic Differences and Trends in ST-Segment Elevation Myocardial Infarction Incidence and Mortality in a Multi-Ethnic Population. Annals of the Academy of Medicine, Singapore, 48(3), 75–85.
Chew, N. W. S., Chong, B., Kuo, S. M., Jayabaskaran, J., Cai, M., Zheng, H., Goh, R., Kong, G., Chin, Y. H., Imran, S. S., Liang, M., Lim, P., Yong, T. H., Liew, B. W., Chia, P. L., Ho, H. H., Foo, D., Khoo, D., Huang, Z., Chua, T., … Chan, M. Y. (2023). Trends and predictions of metabolic risk factors for acute myocardial infarction: findings from a multiethnic nationwide cohort. The Lancet regional health. Western Pacific, 37, 100803. https://doi.org/10.1016/j.lanwpc.2023.100803

PART TWO

Statistical Methods



Statistical Methods

Data Source : National Registry of Diseases Office (2007–2021)

Key Indicators : 1y all-cause mortality of AMI (STEMI) patient

(outcome, from symptom onset to death)

COHORT STUDY

Model

Bayesian Proportional Hazards Models *(Paolucci et al, 2023)*

Multi distribution models to triangulate Hazard Ratios and Failure Time

Markov Chain Monte Carlo chains.

Variables & Results

Gender, age group, comorbidity, BMI(*Body Mass Index*, Asian standard)

Hazard Ratios/Mean of AFT & 95% Credible Intervals

Reference:
Paolucci, I., Lin, Y. M., Albuquerque Marques Silva, J., Brock, K. K., & Odisio, B. C. (2023). Bayesian parametric models for survival prediction in medical applications. BMC medical research methodology, 23(1), 250. https://doi.org/10.1186/s12874-023-02059-4

Operation Codes

Bayesian Survival Models

bayes, nchains(3) mcmcsize(1000) burnin(500/100) rseed(1390):

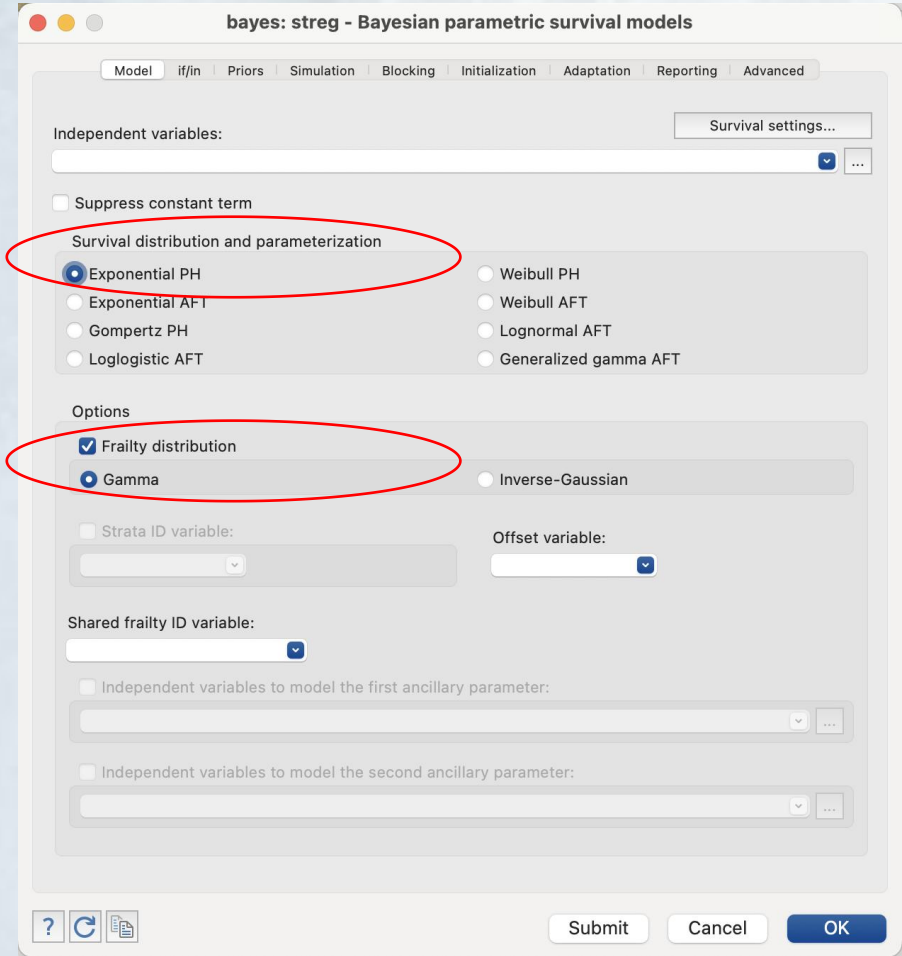
streg i.OnsetAge5Groups, GENDER, RACE, GRACE_Killip, BMI_Asian HT DM RENAL

distribution(exponential/gomperz/weibull/loglogistic) 「time」 frailty(gamma)

Procedure in Stata

「Stata 19.0」 Statistics function Bayesian analysis Regression models Survival models Parametric survival models [lauch]

Independent variables: [next page]



Survival Analysis Results

```
. /* Bayesian Survival Models */
. bayes, nchains(3) mcmcsize(1000) burnin(500) rseed(1390) : streg i.OnsetAge5Groups i.GENDER i.RACE i.GRACE_Killip i.BMI_Asian HT DM
> RENAL if stemi=="S" & order==1, distribution(exponential) frailty(gamma)
note: option adaptation(maxiter()) changed to 15.

        Failure _d: DEATH_1Y==1
  Analysis time _t: surv_len

Chain 1
  Burn-in ...
  Simulation ...

Chain 2
  Burn-in ...
  Simulation ...

Chain 3
  Burn-in ...
  Simulation ...

Model summary
------------------------------------------------------------------------------
Likelihood:
  _t ~ streg_exponential(xb__t,{lntheta})

Priors:
  {_t:i.OnsetAge5Groups} ~ normal(0,10000)                              (1)
          {_t:2.GENDER} ~ normal(0,10000)                               (1)
            {_t:i.RACE} ~ normal(0,10000)                               (1)
    {_t:i.GRACE_Killip} ~ normal(0,10000)                               (1)
       {_t:i.BMI_Asian} ~ normal(0,10000)                               (1)
              {_t:HT} ~ normal(0,10000)                                 (1)
              {_t:DM} ~ normal(0,10000)                                 (1)
           {_t:RENAL} ~ normal(0,10000)                                 (1)
           {_t:_cons} ~ normal(0,10000)                                 (1)
            {lntheta} ~ normal(0,10000)
------------------------------------------------------------------------------
(1) Parameters are elements of the linear form xb__t.

Bayesian exponential PH regression              Number of chains    =         3
Random-walk Metropolis-Hastings sampling        Per MCMC chain:
                                                     Iterations     =     1,500
                                                     Burn-in        =       500
                                                     Sample size    =     1,000
No. of subjects =      26885                    Number of obs       =    26,885
No. of failures =       3136
Time at risk    =166939.5999821496
                                                Avg acceptance rate =     .3468
                                                Avg efficiency: min =    .01494
                                                                avg =    .02858
                                                                max =    .09845
Avg log marginal-likelihood = -15607.761        Max Gelman-Rubin Rc =     4.135
```

Processing...

Model basic information

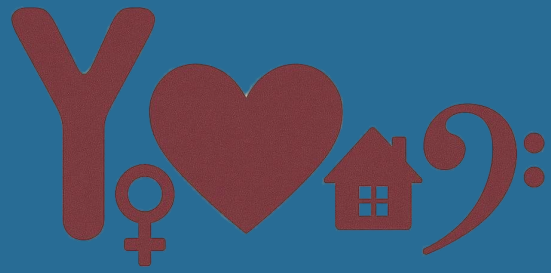
Invoke 3 mcmc chains
Generate 1000 samples simultaneously
Burn-in first 500 initial iteration results
Retain 1000 posterior probability samples.
Name the seed [1390].

Assume: survival time follows EXP distribution.

frailty(gamma): correct "unobserved individual heterogeneity", overcome bias.

PART THREE

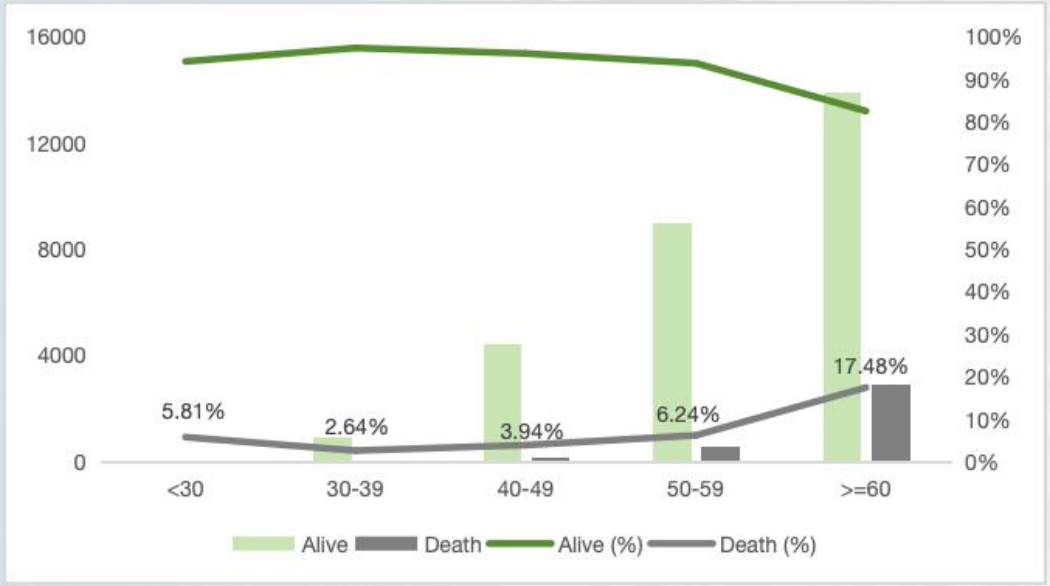
Preliminary result on Stata



Descriptive Results

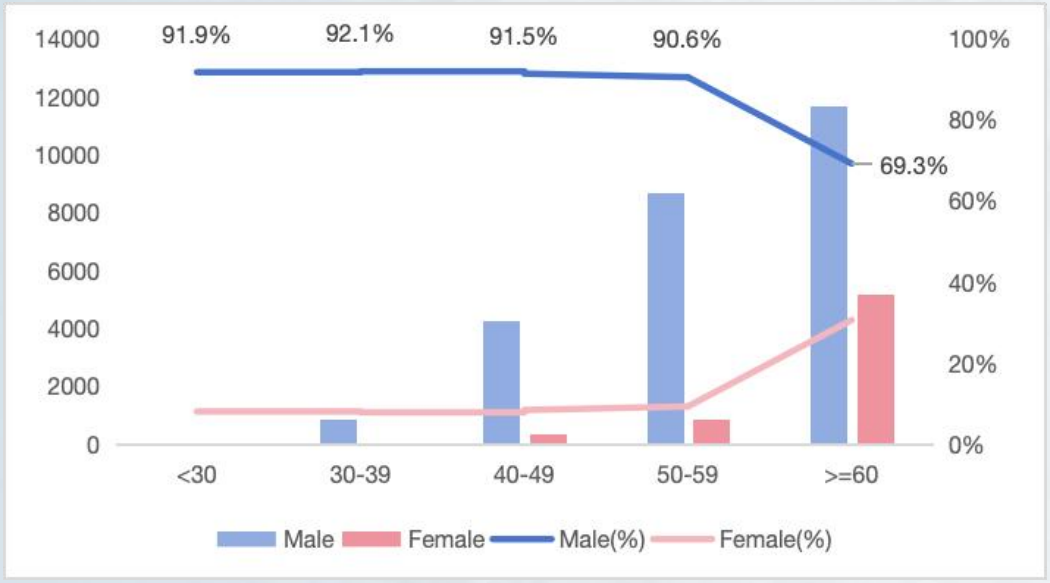
AMI onset mortality(all STEMI patients)

Age	Alive	Alive (%)	Death	Death (%)	*Total*
<30	81	94.19%	5	5.81%	***86***
30-39	921	97.36%	25	2.64%	***946***
40-49	4483	96.06%	184	3.94%	***4667***
50-59	9023	93.76%	600	6.24%	***9623***
>=60	13925	82.52%	2950	17.48%	***16875***
Total	**28433**	**88.31%**	**3764**	**11.69%**	***32197***



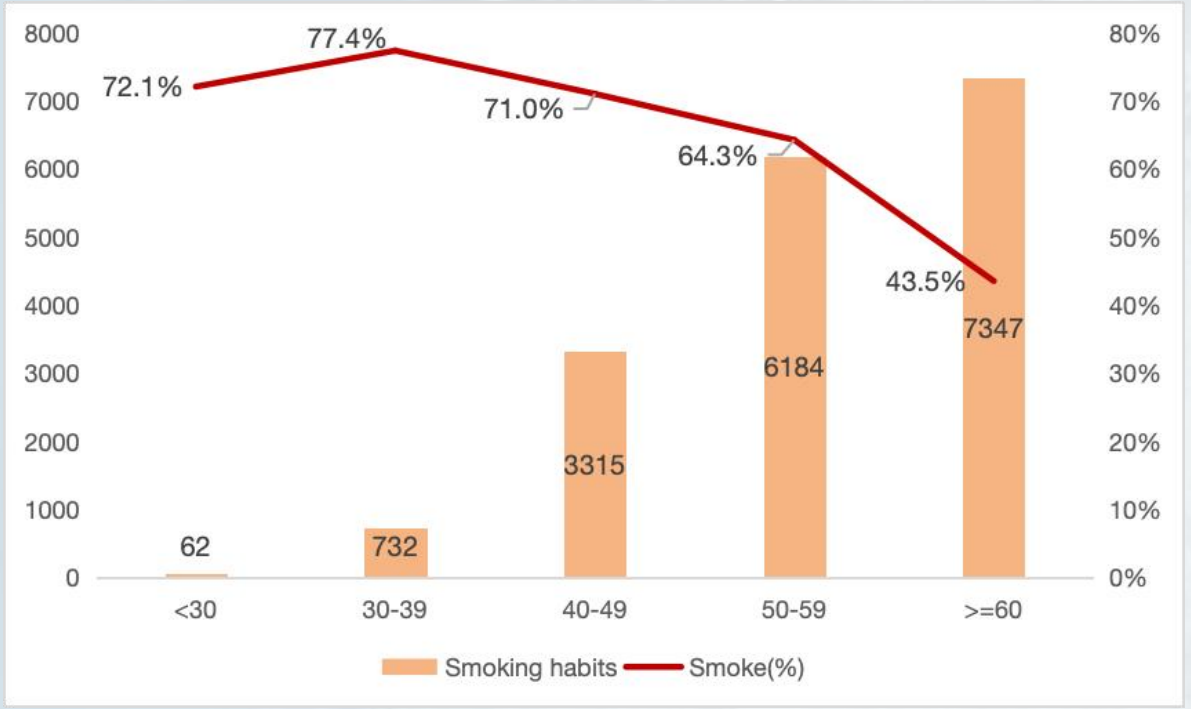
AMI onset mortality(gender)

Age	Male	Male(%)	Female	Female(%)	*Total*
<30	79	91.86%	7	8.14%	***86***
30-39	871	92.07%	75	7.93%	***946***
40-49	4271	91.51%	396	8.49%	***4667***
50-59	8720	90.62%	903	9.38%	***9623***
>=60	11694	69.30%	5181	30.70%	***16875***
Total	**25635**	**79.62%**	**6562**	**20.38%**	***32197***

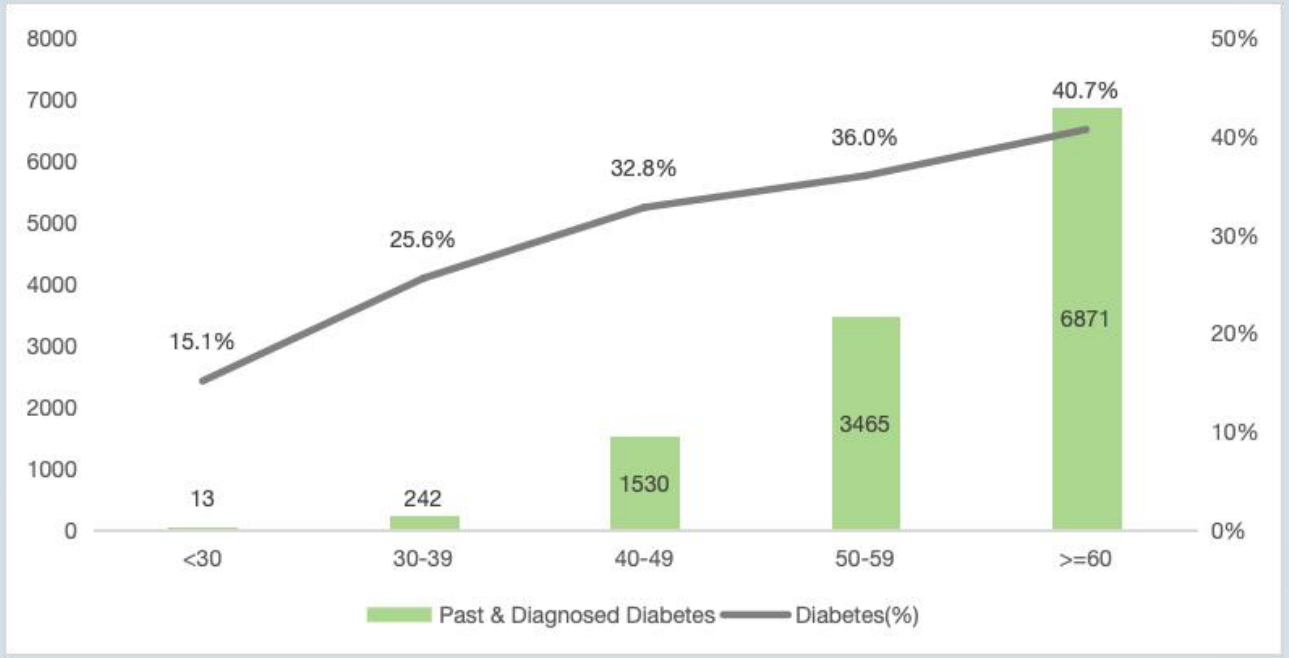


Risky factor trends

Smoking:
Inverted U-shape



Diabetes(Type 2): Monotonous Increase



Survival Analysis Results: *Exponential Regression*

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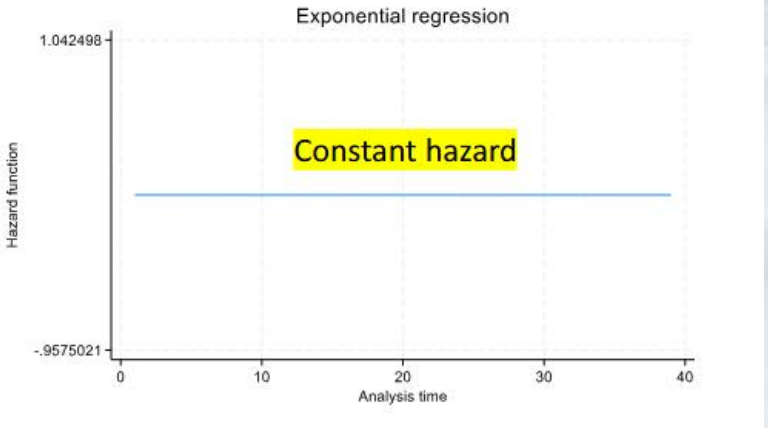
```
(1) Parameters are elements of the linear form xb__t.

Bayesian exponential PH regression              Number of chains    =         3
Random-walk Metropolis-Hastings sampling        Per MCMC chain:
                                                     Iterations     =     1,500
                                                     Burn-in        =       500
                                                     Sample size    =     1,000
No. of subjects =      26885                    Number of obs       =    26,885
No. of failures =       3136
Time at risk    =166939.5999821496
                                                Avg acceptance rate =     .3468
                                                Avg efficiency: min =     .01494
                                                                avg =     .02858
                                                                max =     .09845
Avg log marginal-likelihood = -15607.761        Max Gelman-Rubin Rc =      4.135
```

	Haz. ratio	Std. dev.	MCSE	Median	Equal-tailed [95% cred. interval]	
_t						
OnsetAge5Groups						
30-39	.0613216	.0227388	.002826	.059253	.0333935	.1005782
40-49	.1998115	.0552286	.006142	.1834374	.1390583	.3021761
50-59	.503811	.1316412	.015908	.498651	.2950401	.7265229
>=60	6.402144	1.586267	.203828	6.092044	4.245773	9.164152
GENDER						
Female	3.697834	.3511365	.033833	3.697833	3.110896	4.429424
RACE						
Malay	1.366654	.1513668	.017357	1.362056	1.099165	1.698471
Indian	.6983527	.0866037	.012936	.6838022	.5827887	.9024711
Other	1.451297	.5857181	.064605	1.324993	.7062646	2.392136
GRACE_Killip						
2	6.8802	1.061545	.134174	6.853621	4.94551	8.982785
3	20.88915	4.562902	.587873	20.0461	15.1918	32.89081
4	59.21227	10.25539	1.50187	58.77835	40.95222	76.71658
BMI_Asian						
18.5-22.99	.25238	.04006	.005367	.2521166	.1807556	.3206647
23-24.99	.0992975	.0181731	.002195	.0978478	.0705177	.1379635
>=25	.0658385	.0085086	.000791	.0648061	.0524586	.0823375
HT	1.654722	.1488242	.015008	1.657444	1.381168	1.943509
DM	1.844537	.1822455	.017992	1.847151	1.499117	2.163837
RENAL	11.73795	1.561969	.167953	11.64913	9.269702	14.91354
_cons	.3409738	.0585483	.008181	.3306549	.2514916	.4703581
lntheta	3.435072	.0250205	.001456	3.434783	3.388169	3.483514



Compared to the <30 age group:[30,59] group has lower HR**
Age ≈ protective factor ☑ <30 group has highest Haz. Ratio.

They are young but the disease onset is very severe?

Malay female with comorbidities has higher HR**.
Other: ≈3.5% but insignificant - creditable interval includes 1.

BMI shows negative correlation. - need more confirmation.

GRACE_killip: Risk stratification in acute coronary syndrome
(Tscherny et al, 2020)

Reference:
Tscherny, K., Kienbacher, C., Fuhrmann, V., van Tulder, R., Schreiber, W., Herkner, H., & Roth, D. (2020). Risk stratification in acute coronary syndrome: Evaluation of the GRACE and CRUSADE scores in the setting of a tertiary care centre. International journal of clinical practice, 74(2), e13444. https://doi.org/10.1111/ijcp.13444

Survival Analysis Results: *Exponential AFT (Mean)*

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```
Bayesian exponential AFT regression              Number of chains    =         3
Random-walk Metropolis-Hastings sampling         Per MCMC chain:
                                                      Iterations     =     1,500
                                                      Burn-in        =       500
                                                      Sample size    =     1,000
No. of subjects =      26885                     Number of obs       =    26,885
No. of failures =       3136
Time at risk    =166939.5999821496
                                                 Avg acceptance rate =     .3437
                                                 Avg efficiency: min =    .01302
                                                                 avg =    .02998
                                                                 max =     .1331
Avg log marginal-likelihood = -15616.023         Max Gelman-Rubin Rc =      5.15
```

	Mean	Std. dev.	MCSE	Median	Equal-tailed [95% cred. interval]	
_t						
OnsetAge5Groups						
30-39	2.661244	.6891768	.074931	2.903	1.570419	3.382636
40-49	1.514389	.2827279	.040908	1.53957	.9998585	1.916934
50-59	.6341307	.1361293	.015382	.6444362	.3515777	.8838723
>=60	-1.8712	.1130682	.01238	-1.860167	-2.136948	-1.68215
GENDER						
Female	-1.323913	.1076576	.011564	-1.314634	-1.538497	-1.150572
RACE						
Malay	-.199371	.1466283	.017149	-.2148765	-.4495244	.0849005
Indian	.3482559	.1381195	.014934	.3298772	.0958546	.6109835
Other	-.2039974	.3414481	.039208	-.1485538	-.8695975	.249255
GRACE_Killip						
2	-1.795506	.1908627	.021459	-1.807022	-2.114683	-1.431169
3	-2.869909	.3030208	.039905	-2.934079	-3.265814	-2.42688
4	-4.141405	.1401715	.016628	-4.140968	-4.368488	-3.893079
BMI_Asian						
18.5-22.99	1.407144	.2804412	.044867	1.416114	.9729369	1.836034
23-24.99	2.288209	.2726333	.033009	2.307531	1.896399	2.717576
>=25	2.747114	.2729801	.036527	2.752406	2.380176	3.236396
HT	-.4806433	.1178267	.014741	-.483723	-.6754434	-.233991
DM	-.6863173	.0884196	.010145	-.6861088	-.8453076	-.4923486
RENAL	-2.516968	.140749	.012414	-2.513228	-2.774261	-2.277563
_cons	1.169093	.2442739	.03292	1.100317	.8774358	1.616255
lntheta	3.430562	.0230457	.001153	3.430084	3.386474	3.477113

```
Note: Default priors are used for model parameters.
Note: Default initial values are used for multiple chains.
Note: Adaptation continues during simulation.
```

Compared to <30:
30-39: Mean = 2.66** TR = exp(2.66) ≈ 14.9**, **lower risk.**
40-49: Mean = 1.51** TR = exp(1.51) ≈ 4.5**
50-59: Mean = 0.65** TR = exp(0.65) ≈ 1.9**
⩾60: Mean =-1.87** TR = exp(-1.87) ≈ 0.15**

Female: TR ≈ 0.27**; Malay/Other include 0, show no significance.

Grace_killip TR ≈0.17**, 0.057**, 0.016** - higher risk.

BMI ≈4.1**, 9.9**, 15.6** - **Obesity Paradox?**

ln(theta): →0, same individual; →± , individual difference.

Survival Analysis Results: *Gompertz Regression*

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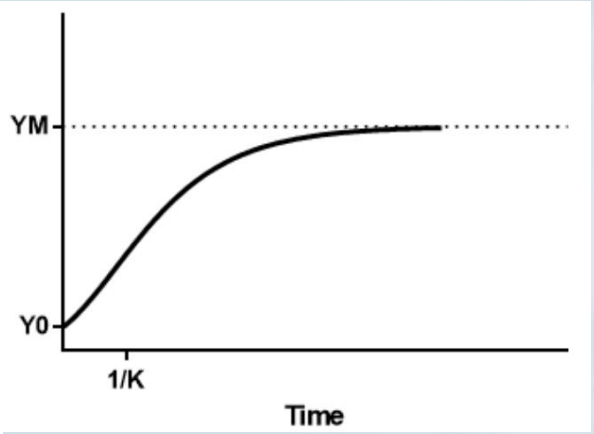
```
(1) Parameters are elements of the linear form xb__t.

Bayesian gompertz PH regression                 Number of chains    =          3
Random-walk Metropolis-Hastings sampling        Per MCMC chain:
                                                     Iterations     =      1,500
                                                     Burn-in        =        500
                                                     Sample size    =      1,000
No. of subjects =      26885                    Number of obs       =     26,885
No. of failures =       3136
Time at risk    =166939.5999821496
                                                Avg acceptance rate =      .2877
                                                Avg efficiency: min =     .01097
                                                                avg =     .02462
                                                                max =     .07228
Avg log marginal-likelihood = -13942.721        Max Gelman-Rubin Rc =      8.293

------------------------------------------------------------------------------
                |                                                 Equal-tailed
                |Haz. ratio   Std. dev.     MCSE     Median  [95% cred. interval]
----------------+-------------------------------------------------------------
_t              |
OnsetAge5Groups |
          30-39 |  .3780824   .1371361   .015433   .3950999    .206619   .6032973
          40-49 |  .5645998   .1508004   .017583   .5051139   .4196974   .8123513
          50-59 |  .8533394   .2641816   .046053   .7934763    .589108   1.239001
            >=60|  2.677207     .75556   .111357   2.411001   1.890399   3.919152
                |
         GENDER |
         Female |  2.597672   .1427991   .017971   2.601964   2.312943   2.856269
                |
           RACE |
         Malay  |  1.083936   .0732542   .008002   1.086581   .9459324   1.227629
        Indian  |  .7959462   .0805515   .011675   .7891366   .6703419   .9471797
         Other  |  1.251526    .596458   .069903   .9848247   .7856579   2.184378
                |
    GRACE_Killip|
              2 |  2.496885   .3175239   .042821   2.512331   1.891084   3.015999
              3 |  6.133897   .7159387   .108404   6.158002   4.816375   7.358392
              4 |  14.00306   1.343884   .211384   13.80313   11.95608   16.44572
                |
      BMI_Asian |
  18.5-22.99    |  .2691059   .0542036   .005649   .2626305   .2047972   .3579319
    23-24.99    |  .1810628   .0462658    .00625   .1696432   .1262332   .2518942
          >=25  |  .1302706   .0297521   .003603   .1231591   .0964614   .1770755
                |
            HT  |  1.363129   .0803325   .012167   1.361901    1.21385   1.530784
            DM  |  1.387152   .0657092   .008504   1.385468   1.273507   1.526232
         RENAL  |  5.216354   .3333179   .040246   5.227058   4.534772   5.775793
          _cons |  .5908933   .1594475   .021607   .5293474   .4475132   .8891491
----------------+-------------------------------------------------------------
         gamma  | -3.51935    .0938481   .006373   -3.51827  -3.709702  -3.343872
       lntheta  |  1.739007   .0502509   .003734   1.739606   1.640647    1.83506
------------------------------------------------------------------------------
Note: Estimates are transformed only in the first equation to hazard ratios.
Note: _cons estimates baseline hazard.
Note: Default priors are used for model parameters.
Note: Default initial values are used for multiple chains.
Note: Adaptation continues during simulation.
Note: Adaptation tolerance is not met in at least one of the blocks in at least
      one of the chains.
```



Age increases while hazard decreases(except age ⩾ 60)

Female**, Malay(no significance)

BMI - protective factor.

Renal insufficiency HR > 5, strongest independent risk factor.

The shape parameter risk decreases over time, possibly from deliberate efforts.

Survival Analysis Results: *Weilbull Regression*

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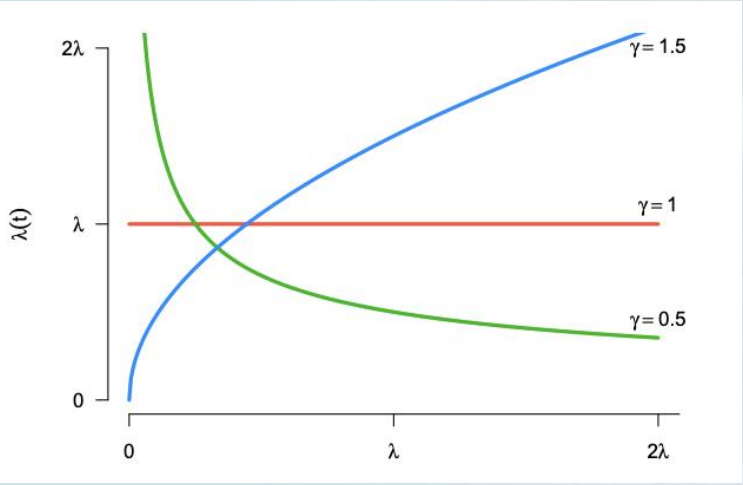
(1) Parameters are elements of the linear form xb__t.

Bayesian Weibull PH regression — Number of chains = 3
Random-walk Metropolis-Hastings sampling — Per MCMC chain:
Iterations = 1,500
Burn-in = 500
Sample size = 1,000
No. of subjects = 26885 — Number of obs = 26,885
No. of failures = 3136
Time at risk =166939.5999821496
Avg acceptance rate = .3075
Avg efficiency: min = .006037
avg = .0129
max = .02693
Avg log marginal-likelihood = -15380.091 — Max Gelman-Rubin Rc = 10.33

	Haz. ratio	Std. dev.	MCSE	Median	Equal-tailed [95% cred. interval]
_t					
OnsetAge5Groups					
30-39	.1789045	.1071606	.018924	.1981013	.0465916 .3149098
40-49	.3827867	.2292867	.039197	.4075657	.1333084 .7180711
50-59	.601007	.3308189	.055988	.6206671	.2481717 1.02801
>=60	2.394564	1.500985	.167004	2.375891	.8890758 4.393829
GENDER					
Female	2.575564	.2454759	.044609	2.545667	2.196264 3.080275
RACE					
Malay	1.189153	.0893065	.016345	1.194537	1.021315 1.349025
Indian	.7977522	.0862626	.012712	.8033696	.6283737 .9501507
Other	.7665362	.2437076	.033973	.6958277	.382046 1.100881
GRACE_Killip					
2	2.469967	.2991625	.045378	2.520837	1.90458 2.898036
3	7.218489	1.208483	.235616	7.095185	5.504604 9.116068
4	12.41803	3.022279	.599466	11.6437	9.319065 18.82889
BMI_Asian					
18.5-22.99	.2967317	.0794751	.01326	.2669616	.2240706 .4265257
23-24.99	.1916182	.0681878	.013313	.1624826	.1291041 .2992834
>=25	.1333021	.0387195	.009099	.1184743	.090998 .1922797
HT	1.33012	.0837982	.011325	1.326284	1.17776 1.488004
DM	1.429154	.0968665	.013833	1.423748	1.267385 1.605183
RENAL	5.512265	.4695405	.066365	5.412254	4.818463 6.757893
_cons	.1312123	.0634108	.011501	.1130407	.0632795 .2116513
ln_p	-.8096181	.0579023	.009541	-.8163769	-.891833 -.7158888
lntheta	1.920337	.1368403	.022196	1.924708	1.724121 2.135674



Age, Gender, Race, Killip, BMI(obesity paradox) and comorbidities, ***differences and significance still exist***

ln_p = - 0.81, shape parameter (p) ≈ 0.44

Survival Analysis Results: *Weibull AFT (Mean)*

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```
(1) Parameters are elements of the linear form xb__t.

Bayesian Weibull AFT regression                 Number of chains    =          3
Random-walk Metropolis-Hastings sampling        Per MCMC chain:
                                                     Iterations     =      1,500
                                                     Burn-in        =        500
                                                     Sample size    =      1,000
No. of subjects =      26885                    Number of obs       =     26,885
No. of failures =       3136
Time at risk    =166939.5999821496
                                                Avg acceptance rate =      .2954
                                                Avg efficiency: min =     .01385
                                                                avg =     .02039
                                                                max =      .0293
Avg log marginal-likelihood = -15366.153        Max Gelman-Rubin Rc =      5.353

------------------------------------------------------------------------------
             |                                                 Equal-tailed
             |      Mean   Std. dev.     MCSE     Median  [95% cred. interval]
-------------+----------------------------------------------------------------
_t           |
OnsetAge5Gro~s |
       30-39 |  3.298256   .6021213     .0808   3.383978   2.490672   4.158137
       40-49 |  2.316928   .5368706    .07986   2.207992   1.687725    3.12324
       50-59 |  1.557704   .3851253    .054001   1.655233   .9218914   2.045783
         >=60 | -1.562262    .339439    .042108  -1.469807  -2.189203  -1.171278
              |
      GENDER |
      Female | -1.926342   .1727044    .022861  -1.940661  -2.195634  -1.613161
              |
        RACE |
       Malay | -.2770544   .1727008    .021012  -.2885801   -.548798   .0353695
      Indian |  .5265268   .1555571    .019289   .5266496   .2267521   .8279968
       Other | -.5180271   .3362966    .040324  -.4966714  -1.160376  -.0008912
              |
 GRACE_Killip |
           2  | -2.115583   .2778842    .032757  -2.118699   -2.57313  -1.688559
           3  | -3.702985   .4932746    .068455  -3.865999  -4.188373  -2.940197
           4  | -5.422901   .2653199    .034198  -5.447324  -5.875275  -4.986793
              |
    BMI_Asian |
 18.5-22.99   |  3.123108   .1585819    .016916   3.111108   2.869125   3.411502
   23-24.99   |  4.351468   .2363182    .027463   4.321447   4.015594   4.754839
         >=25 |  5.004409   .1783928    .021455   5.012216   4.708609    5.27713
              |
           HT | -.7424736   .1240354    .016133  -.7400438  -.9513915  -.4998997
           DM | -.8014683   .1133457    .014759  -.8069308  -1.015038  -.5329939
        RENAL | -3.875366   .1338653    .018716   -3.87398  -4.156934  -3.608292
        _cons |  4.421282   .6105823    .094719   4.367822    3.65824    5.3545
-------------+----------------------------------------------------------------
         ln_p | -.8266254    .027028    .003789  -.828974  -.8663694  -.7772558
      lntheta |  1.870426    .057009    .006767   1.871201   1.771614   1.983794
------------------------------------------------------------------------------
```

Compared to <30:

30-39: Mean = 2.66** TR = exp(2.66) ≈ 14.9**, longer life.

40-49: Mean = 1.51** TR = exp(1.51) ≈ 4.5**

50-59: Mean = 0.65** TR = exp(0.65) ≈ 1.9**

⩾60: Mean =-1.87** TR = exp(-1.87) ≈ 0.15**, shorter life.

Female**,
Malay and Other race**,
Thin but dangerous**.

Survival Analysis Results: *Log-logistic AFT (Mean)*

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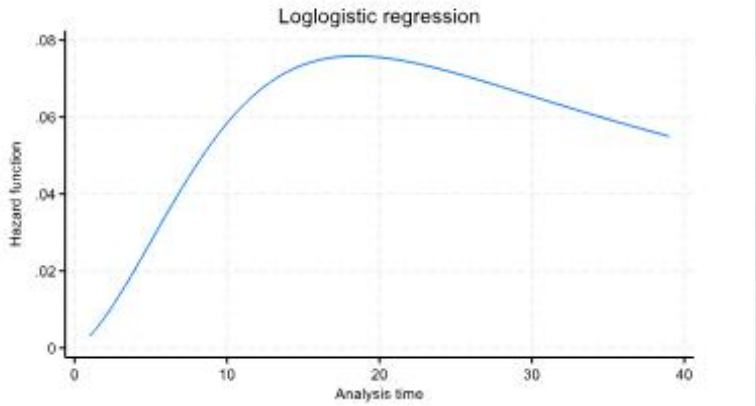
```
(1) Parameters are elements of the linear form xb__t.

Bayesian loglogistic AFT regression             Number of chains    =         3
Random-walk Metropolis-Hastings sampling        Per MCMC chain:
                                                     Iterations     =     1,500
                                                     Burn-in        =       500
                                                     Sample size    =     1,000
No. of subjects =      26885                    Number of obs       =    26,885
No. of failures =       3136
Time at risk    =166939.5999821496
                                                Avg acceptance rate =     .3052
                                                Avg efficiency: min =   .009909
                                                                avg =    .01962
                                                                max =    .03295
Avg log marginal-likelihood = -15381.282        Max Gelman-Rubin Rc =      10.18

------------------------------------------------------------------------------
             |                                                 Equal-tailed
             |      Mean   Std. dev.     MCSE     Median  [95% cred. interval]
-------------+----------------------------------------------------------------
_t           |
OnsetAge5Gro~s |
       30-39 |  4.003166   1.203787   .133772   3.656998   2.930791   5.538332
       40-49 |   2.27838   .7220308   .098308   2.088076   1.506617   3.211352
       50-59 |  1.325081   .3823751   .070131   1.252208   .7607498   1.839738
        >=60 | -1.817051   .4780201   .064533  -1.987812  -2.319003  -1.079064
             |
      GENDER |
      Female | -1.894435   .1832646    .02404   -1.92182  -2.188111  -1.532113
             |
        RACE |
       Malay | -.4285697   .1586435   .021329  -.4103399  -.7822975  -.1811639
      Indian |  .5473866   .1676562   .016863   .5315407   .2530756   .8991285
       Other | -.5067551   1.024273   .176409  -.6391571  -1.600108   .9151523
             |
 GRACE_Killip |
           2 | -2.408066   .4024284   .055932  -2.319204  -3.014218  -1.919825
           3 | -4.126582   .2778301   .040035  -4.165554  -4.484076  -3.598323
           4 | -5.523052   .3133991   .041536   -5.55631  -5.982242  -5.038095
             |
    BMI_Asian |
 18.5-22.99   |  3.131946   .6474998    .08761   3.023029   2.431075   4.059045
   23-24.99   |   4.49793   .8879543   .102919   4.196793    3.60978   5.666223
       >=25   |   5.07158   .7477939    .08874   4.851224    4.29354    6.14088
             |
           HT | -.7626317   .1285424   .018735  -.7675329  -1.002732  -.5078643
           DM |   -.86008   .1359871   .017409  -.8398116  -1.097909  -.646353
        RENAL | -4.041957    .282094   .034312  -4.027805  -4.525444  -3.649635
        _cons |  5.936879   .2222412   .032456    5.94606   5.545772   6.341635
-------------+----------------------------------------------------------------
      lngamma |  .9630223   .0445569   .006988   .9539148   .9071931   1.036637
      lntheta |  1.003909   .1415036   .014787   1.025381   .7382916   1.198529
------------------------------------------------------------------------------
Note: Default priors are used for model parameters.
Note: Default initial values are used for multiple chains.
Note: Adaptation continues during simulation.
```



non-monotonous

Age, Gender, Race, BMI(obesity paradox) and comorbidities, ***differences and significance still exist***

Survival Analysis Results: *Log-normal AFT (Mean)*

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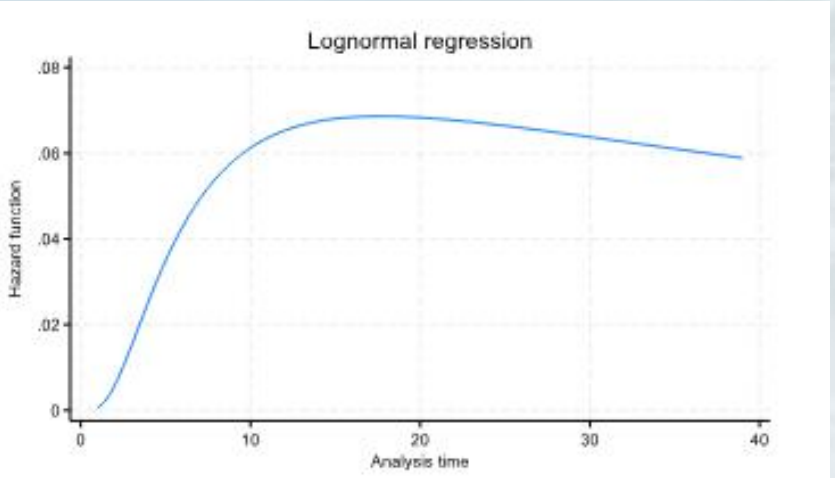
(1) Parameters are elements of the linear form xb__t.

Bayesian lognormal AFT regression — Number of chains = 3
Random-walk Metropolis-Hastings sampling — Per MCMC chain:
Iterations = 1,500
Burn-in = 500
Sample size = 1,000
No. of subjects = 26885 — Number of obs = 26,885
No. of failures = 3136
Time at risk = 166939.5999821496
Avg acceptance rate = .3177
Avg efficiency: min = .007709
avg = .01637
max = .03256
Avg log marginal-likelihood = -15363.04 — Max Gelman-Rubin Rc = 11.31

	Mean	Std. dev.	MCSE	Median	Equal-tailed [95% cred. interval]
_t					
OnsetAge5Groups					
30-39	3.076866	.6219079	.083433	3.263578	2.231098 3.805509
40-49	1.790814	.4074696	.055655	1.849433	.6980854 2.365561
50-59	.7372136	.667458	.118204	.9553953	-.4046798 1.511845
>=60	-2.298433	.5364602	.090704	-2.130225	-3.389133 -1.748655
GENDER					
Female	-2.149569	.3676693	.054192	-2.04599	-2.774245 -1.727608
RACE					
Malay	-.2327651	.308411	.046455	-.2924208	-.6401145 .2028653
Indian	.2968753	.2469368	.031393	.3071166	-.105256 .7693706
Other	-.1825882	1.334573	.210679	-.5216336	-1.509699 1.865974
GRACE_Killip					
2	-2.627655	.48945	.079765	-2.587211	-3.274422 -1.881997
3	-4.383519	.3115113	.031519	-4.303242	-4.915791 -4.010088
4	-5.872896	.6025929	.067628	-5.653437	-6.741042 -5.242954
BMI_Asian					
18.5-22.99	3.336582	.4438741	.064038	3.239756	2.661343 3.943942
23-24.99	4.869141	.8031576	.139962	4.485248	4.2069 5.976591
>=25	5.383111	.5360726	.111475	5.152536	4.887931 6.111144
HT	-.7695562	.124396	.017594	-.772534	-1.007498 -.5469194
DM	-.9434733	.2131221	.034933	-.9275896	-1.298108 -.6327771
RENAL	-4.21111	.2463789	.033838	-4.16304	-4.718952 -3.892175
_cons	8.6573	1.323575	.192244	8.141945	7.424621 10.39523
lnsigma	1.806126	.0640021	.009905	1.823995	1.718706 1.884287
lntheta	-.0581793	.4134165	.050977	-.0260727	-.8273469 .4324824

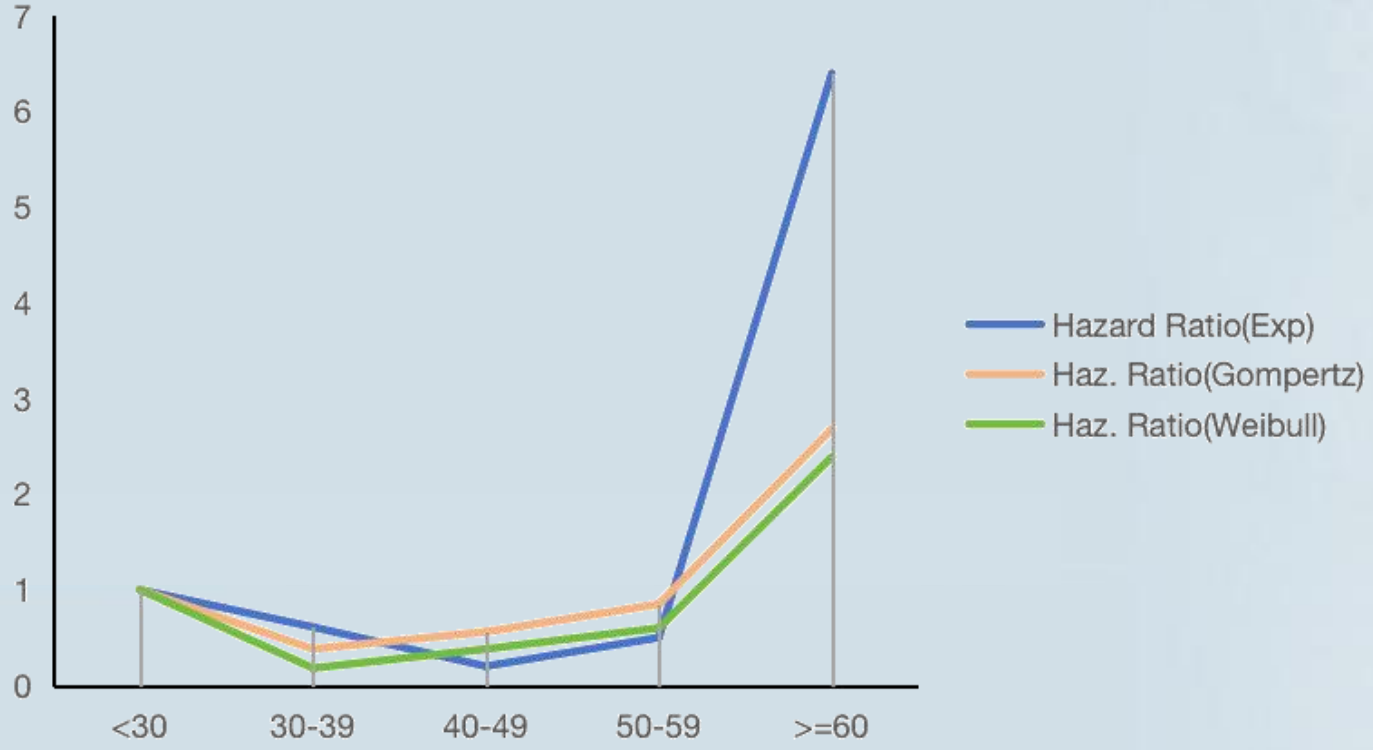


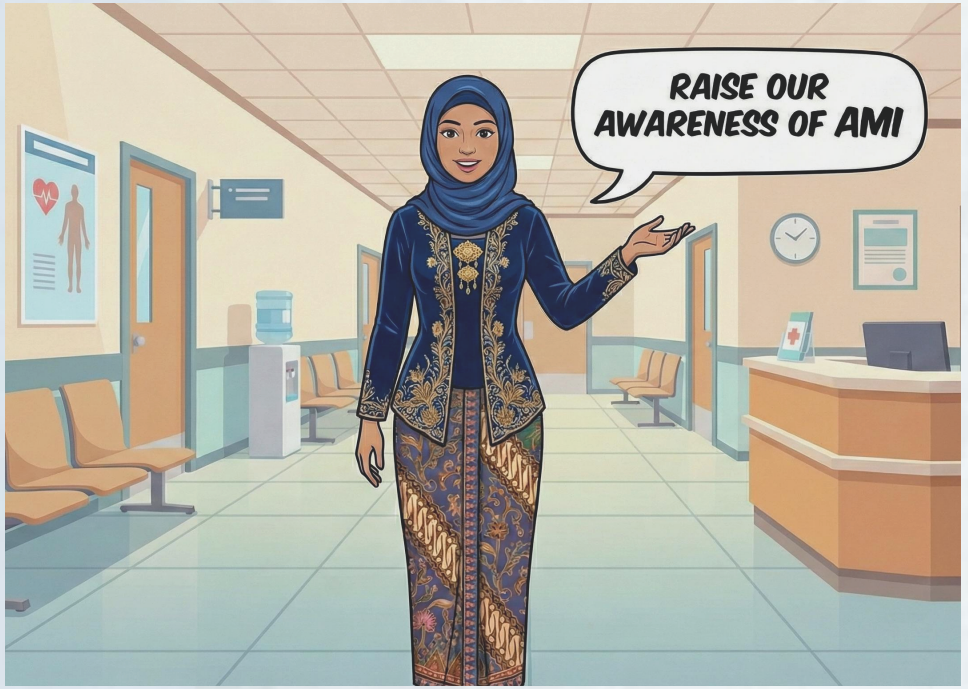
non-monotonous & long-tail

Age, Gender, Race, BMI(obesity paradox) and comorbidities,
differences and significance still exist

Analysis Results - Target Profile

Age <30, Female, Malays
(may have low BMI or other unhealthy lifestyle, comorbidities)
BMI <18.5 = 1.6 m ~ 47 kg





-Generated by Google Gemini

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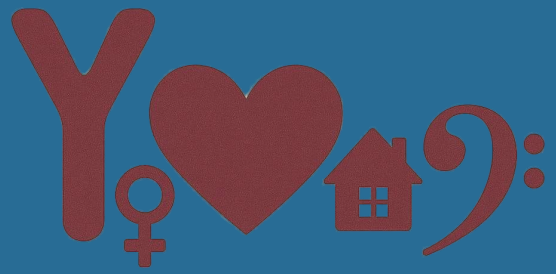
PART FOUR

Conclusions & Recommendations



Discussion & Recommendations

-Generated by Google Gemini

Aware of

"Thin Outside, Fat Inside"

Mindfulness Circles

Peers & Interaction Influencers

Social Contagion

Nasi Lemak, Santan, Goreng...

Healthy food unacessible.

High-pressure workplace.

Few wellness Break

Few Smoking Session

Conclusions & Recommendations

Thank you

Xiao Luyang
Behavioural and Implementation Science in Healthcare

NUS National University of Singapore
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