



# Risk factors for Thoroughbred racehorse fatality in flat races in Victoria between 1989 and 2004

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# Racetrack Industry Research



- Horse welfare
- Jockey welfare

# Previous Studies of Risk Factors

- Multiple international studies of racetrack wastage
- Most investigated risk factors at univariate level
- Few investigated risk factors at multivariable level

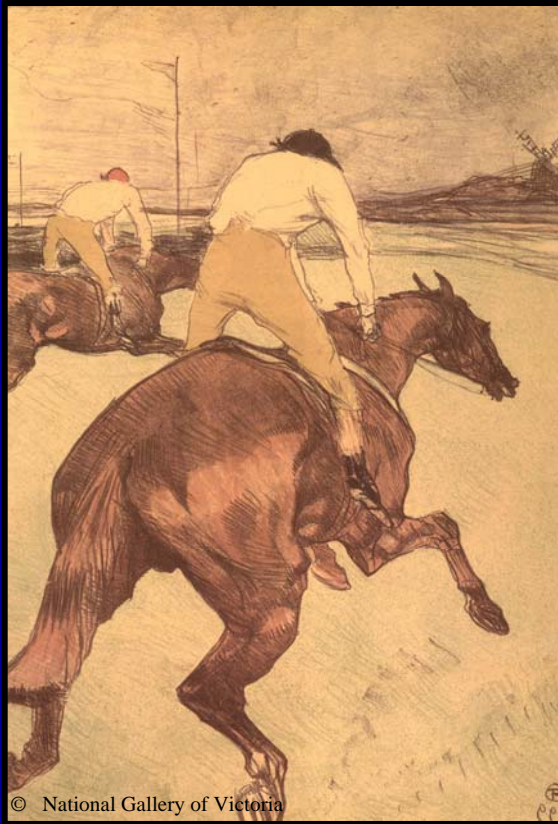


# Limitations of Previous Studies

- Confounders
- Small number of cases
- Lack of consistency in case definition
- Failure to select representative controls
- Differences in risk factors between and within countries

- Only two previous Australian studies of risk factors for racehorse fatality



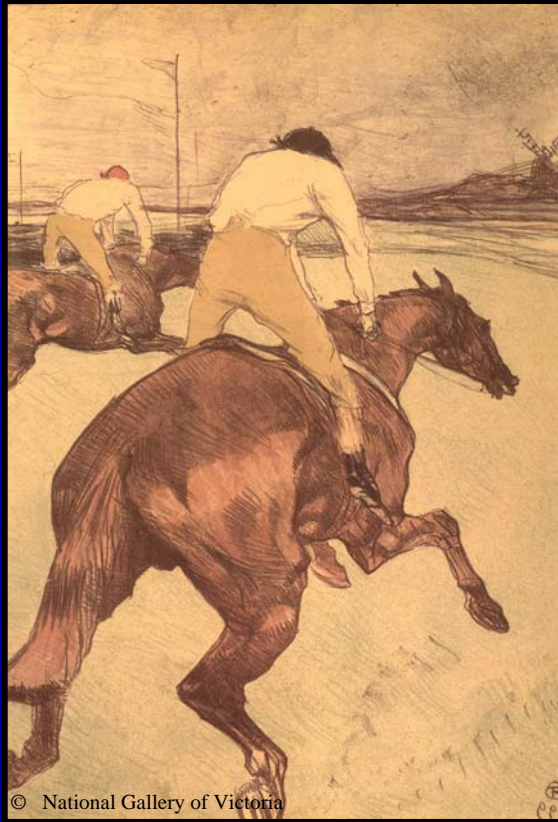


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Bailey CJ, Reid SW, Hodgson DR,  
Suann CJ, Rose RJ.

Risk factors associated with  
musculoskeletal injuries in Australian  
Thoroughbred racehorses.

*Prev Vet Med* 1997; 32:47-55



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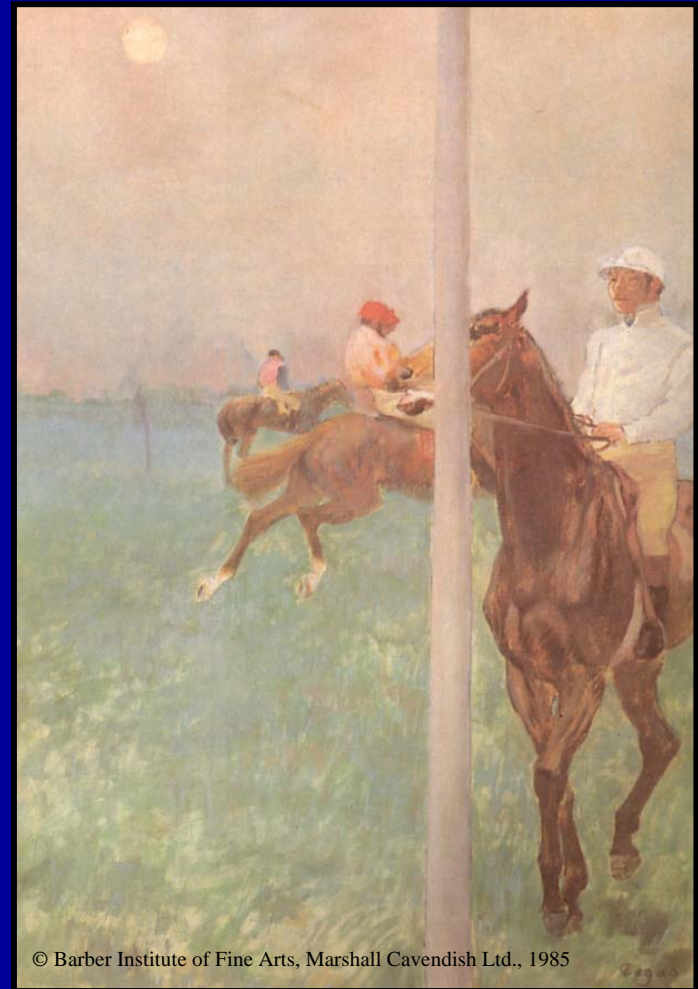
## Risk Factors

- Age (greater than 4 years)
- Barrier position (7-18)
- Distance change (increase)
- Class of race (stakes races)

Bailey CJ, Reid SW,  
Hodgson DR, Bourke JM,  
Rose RJ.

Flat, hurdle and steeple  
racing: risk factors for  
musculoskeletal injury.

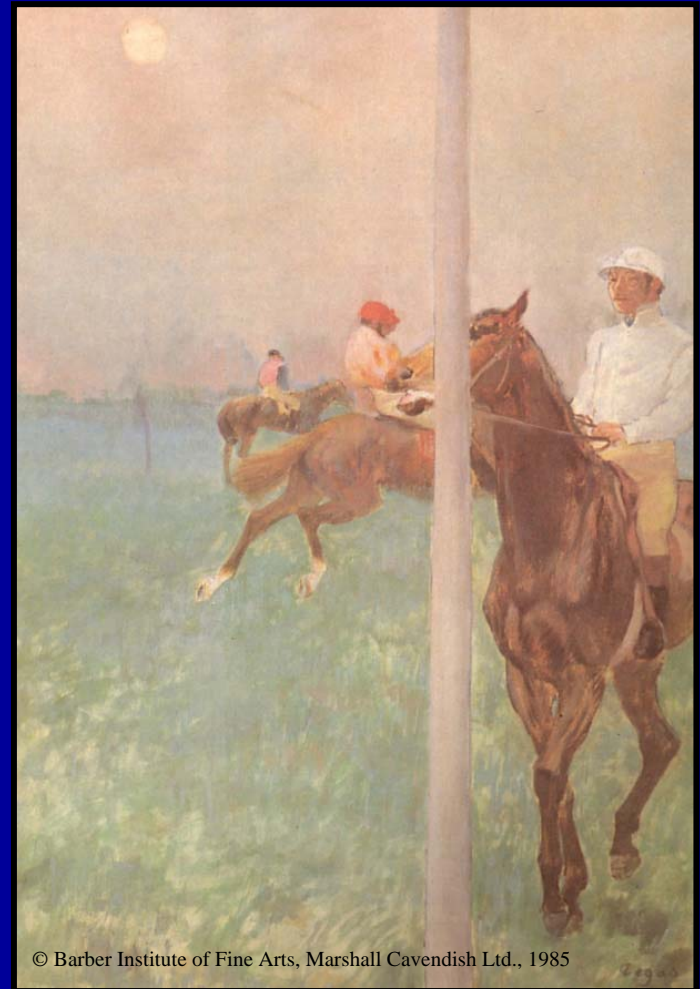
*Eq vet J* 1998; 30: 498-503



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## Risk Factors

- Age (greater than 5 years)
- Track condition (firm tracks)
- Race type (hurdles and steeplechases)



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# Rationale for New Study

- Refined case definition
- Restriction of race type
- Long study period
- Currency
- Benchmark for comparison with previous and future studies

# Objective

To identify risk factors for fatality in flat races on both country and city racecourses in Victoria over last 15 years



# Materials and Methods

- Retrospective nested case control study
- Restricted population – flat starts
- City racecourses (4)
  - Flemington, Sandown, Caulfield, Moonee Valley
- Country racecourses (53)

# Data Sources

## The Victorian Racing Industry

- AAP (Australian Associated Press) database
- *i*-RIS horse database (Racing Victoria Limited)
- Case data from Racing Victoria Limited

# Racing Fatality

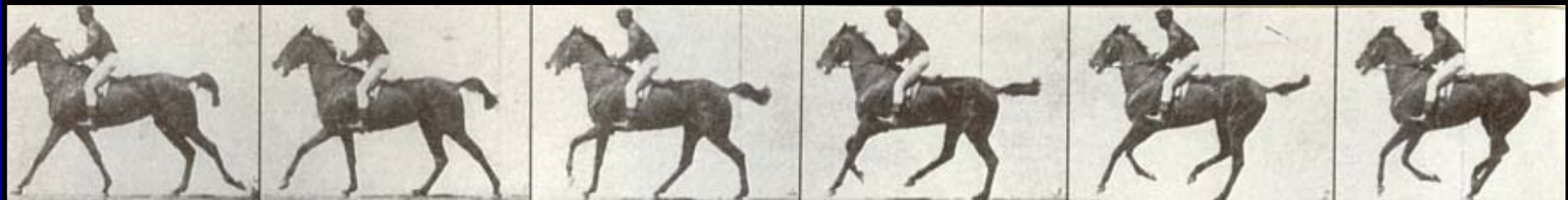
- A horse that died suddenly or immediately after a race
- A horse that was euthanised within 24 hours of a race as a consequence of injury sustained during that race
- 285 case starts eligible for inclusion in the study

## Criteria for Exclusion

- 31 horses excluded from case series due to erroneous database entries for race date or location

# Control Selection

- Simple random selection from starts
- An individual horse could be selected as a control start and as a case start.
- A start ending in fatality was not eligible to be a control start.
- 3520 controls selected (12 controls per case)



# Statistical Analysis

Power of study – 90%

- Odds Ratio 1.8 or greater
- 0.05 significance level
- Prevalence of exposure in the control group assumed to be 0.1

# Statistical Analysis

## Clustering

- Single level model used for model building
- Investigated clustering at level of horse, trainer, jockey and track
- Results adjusted for clustering by using a random effects model

# Identification of Risk Factors

Based on literature and *a priori* hypotheses

- Horse factors
- Race factors
- Jockey factors
- Track factors



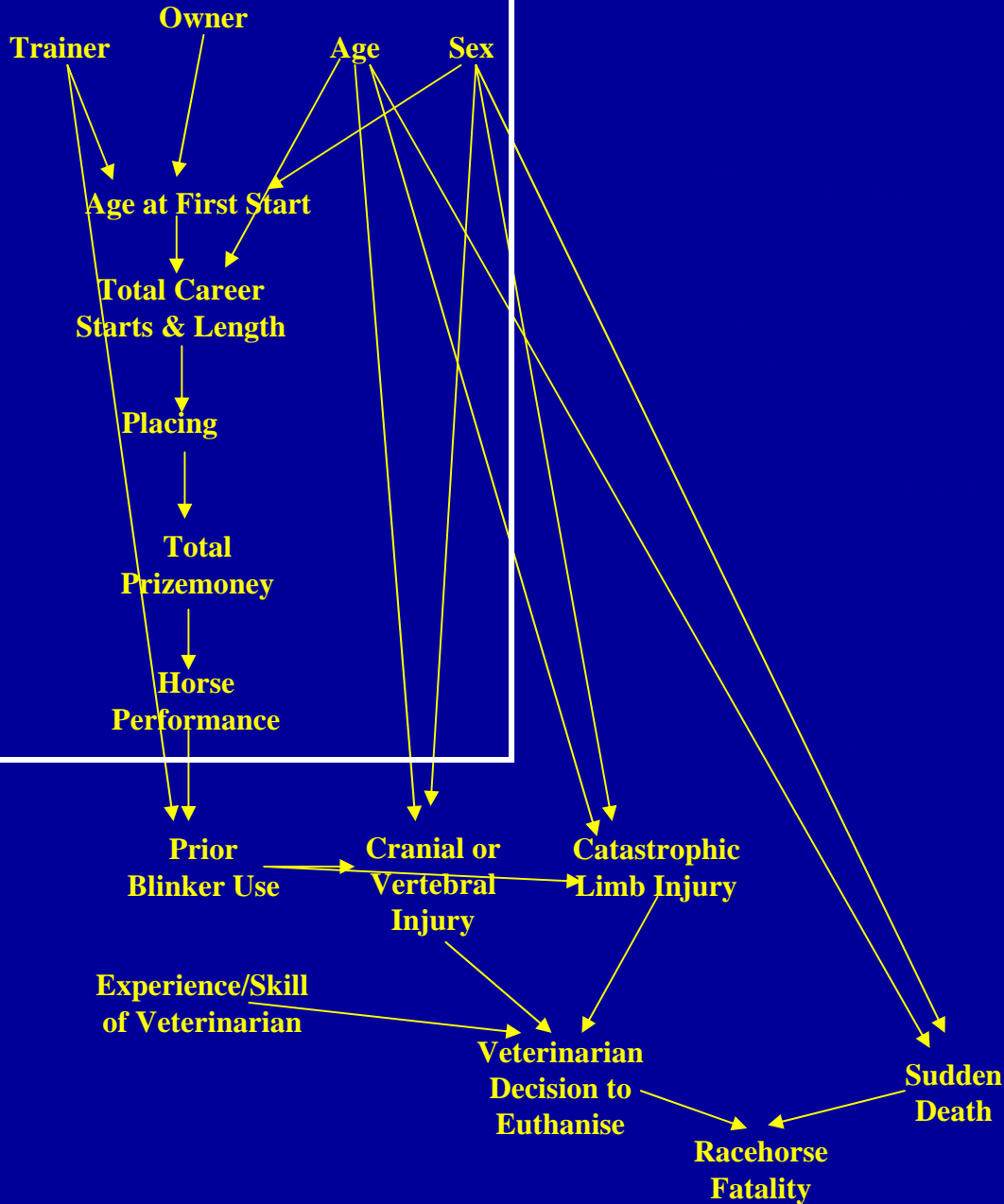
# Horse Factors



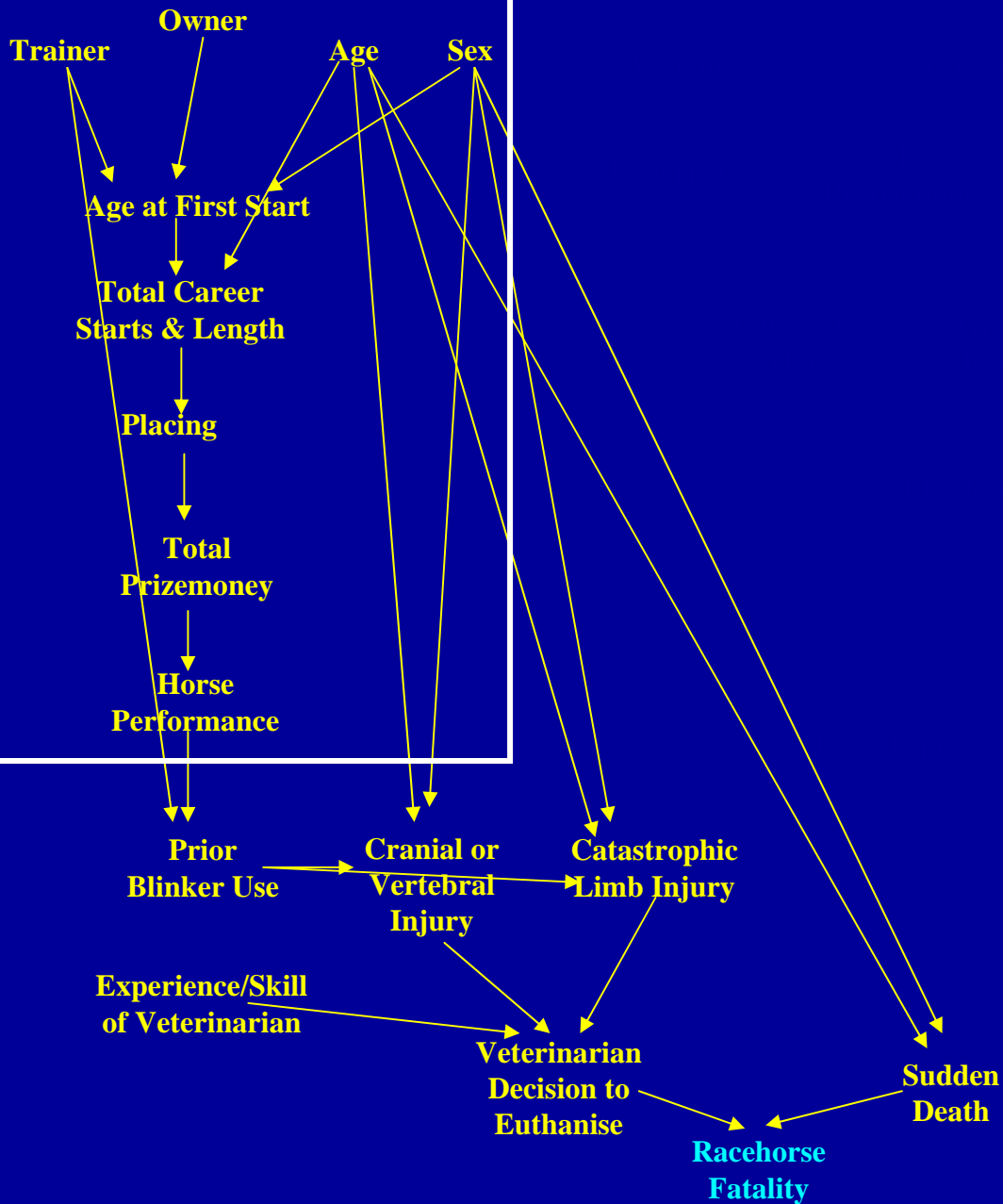
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- Age
- Sex (male or female)
- Form history
  - age at first start
  - career length in years
  - history of blinker use

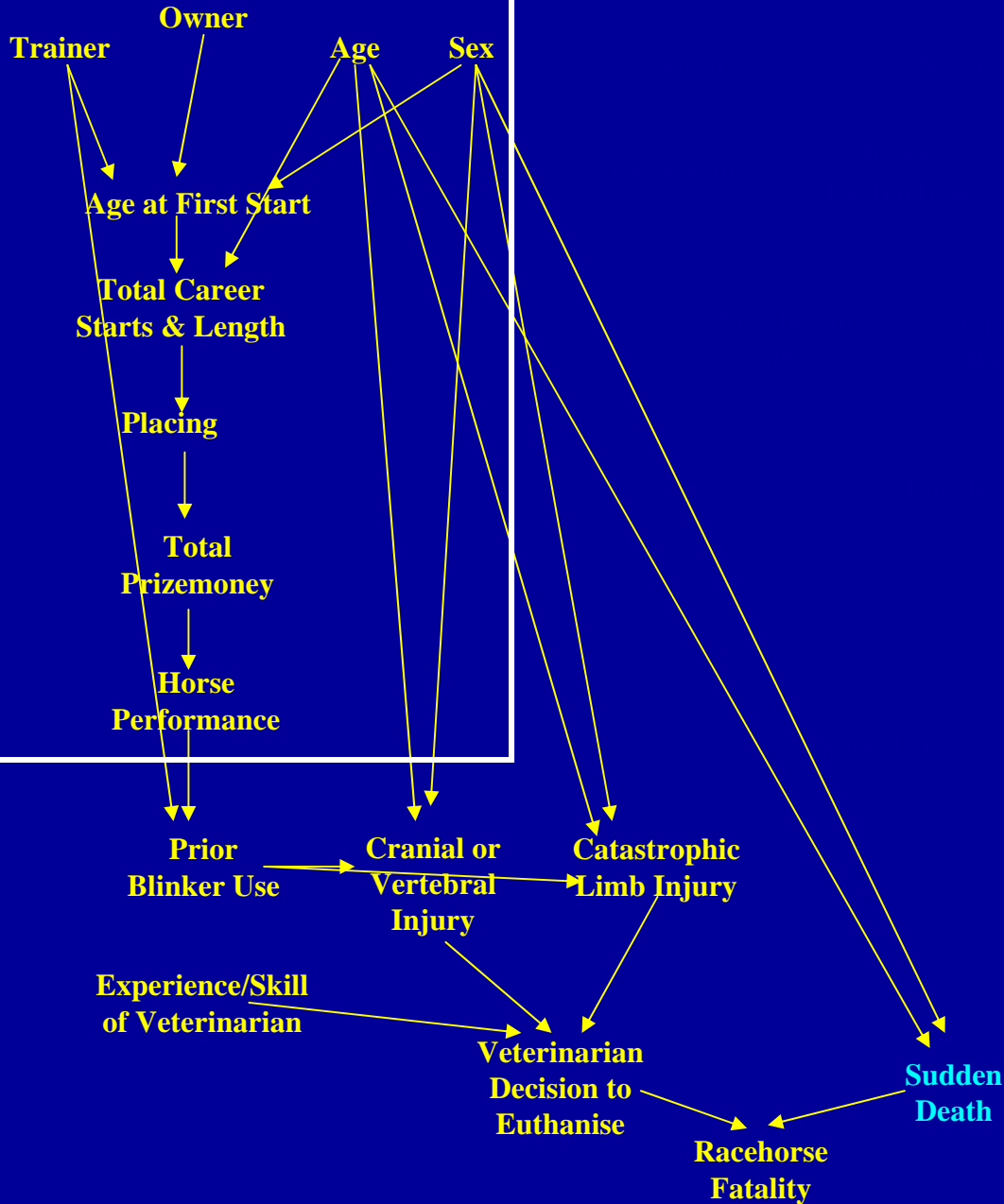
# HORSE



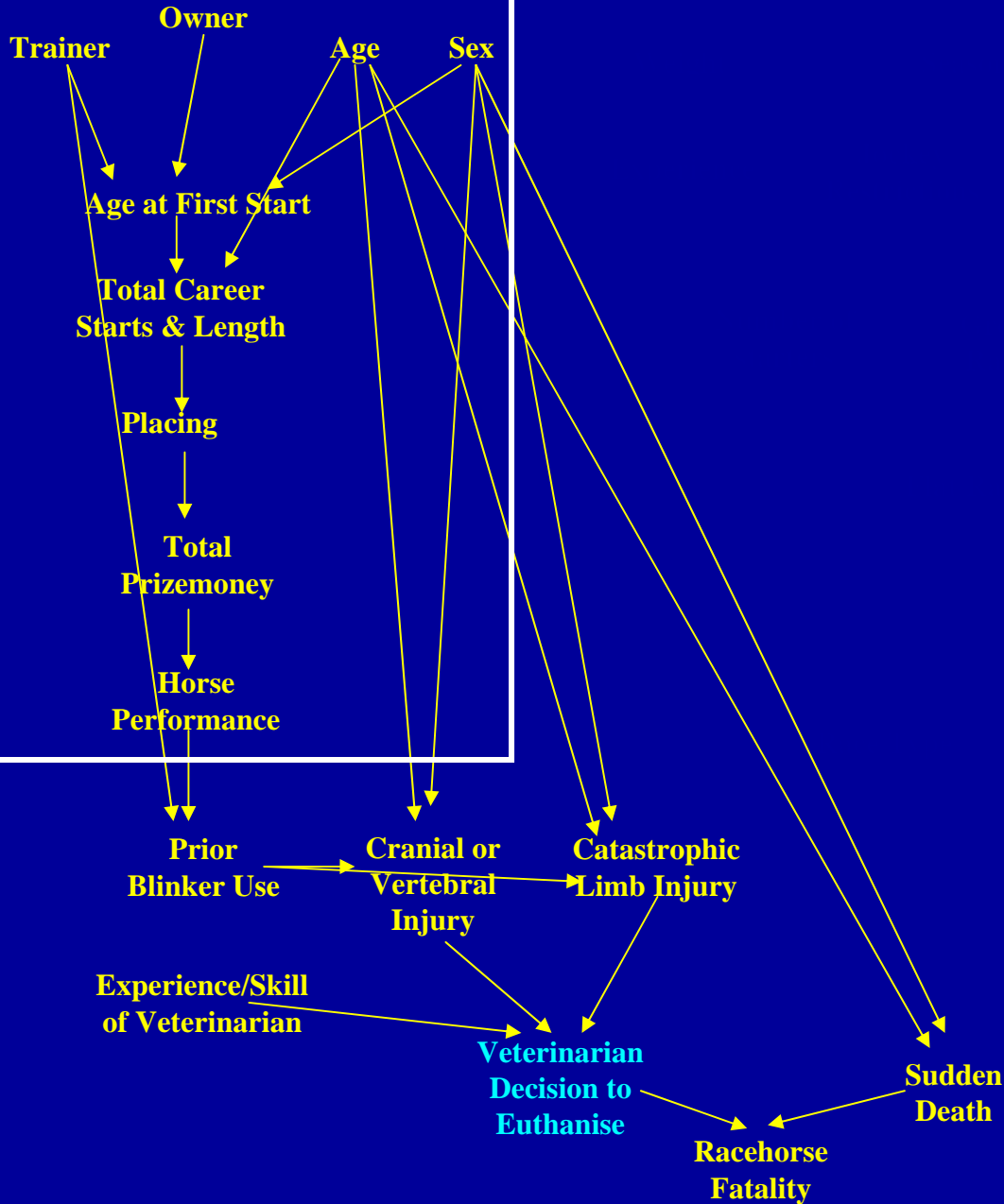
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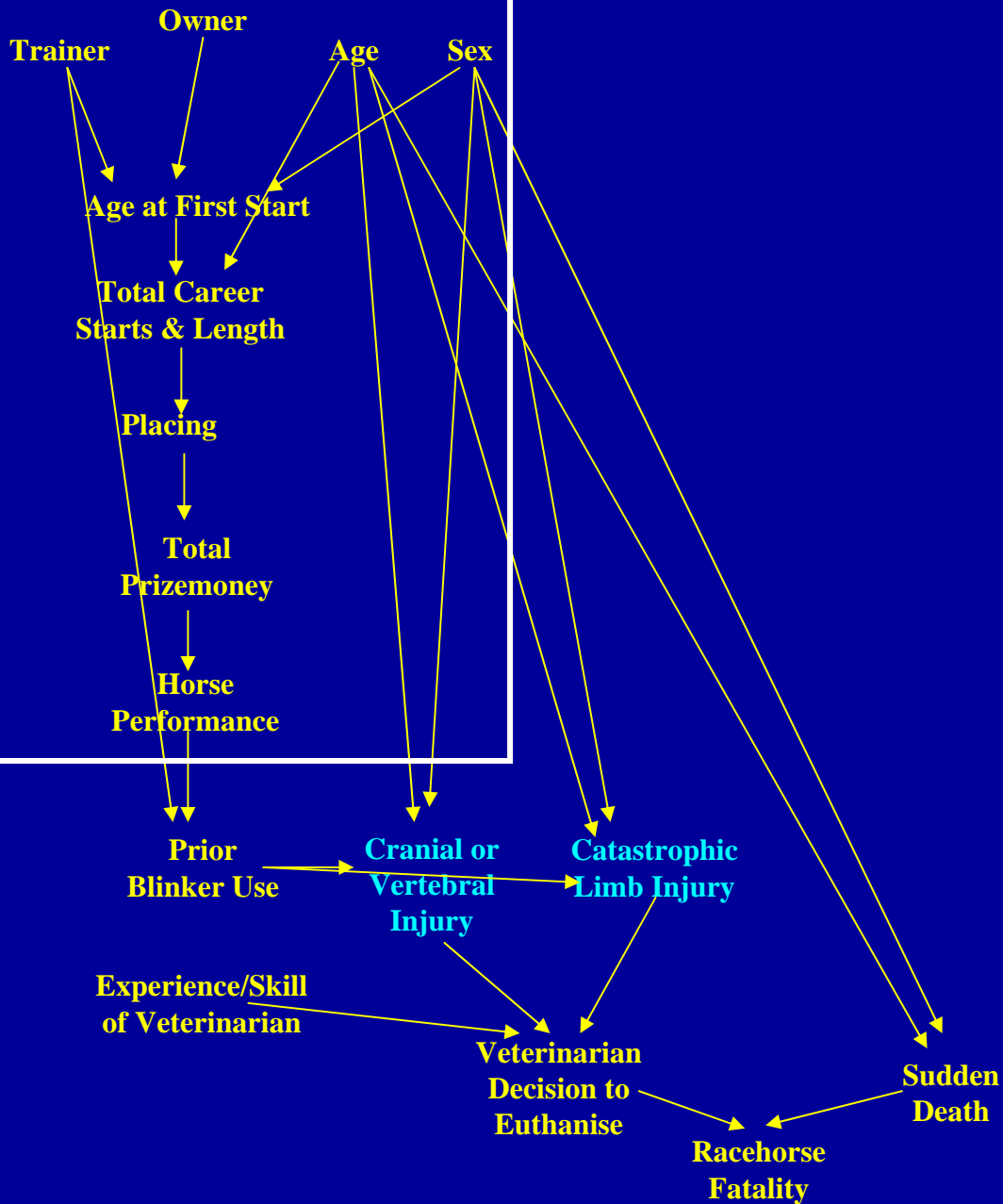
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# HORSE



# HORSE



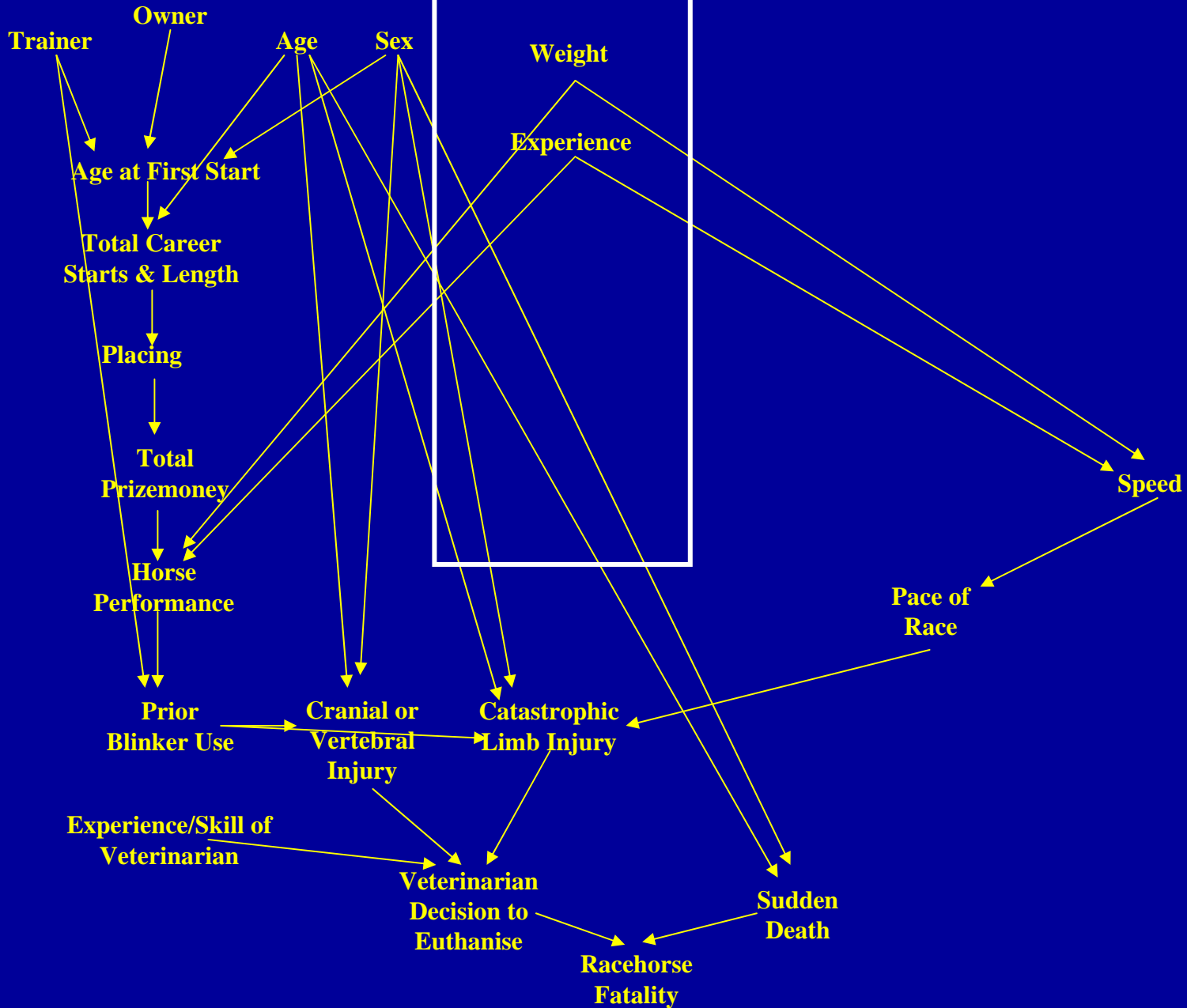
# Jockey Factors

- Jockey experience
- Jockey weight (kg)



# HORSE

# JOCKEY



# Race Factors

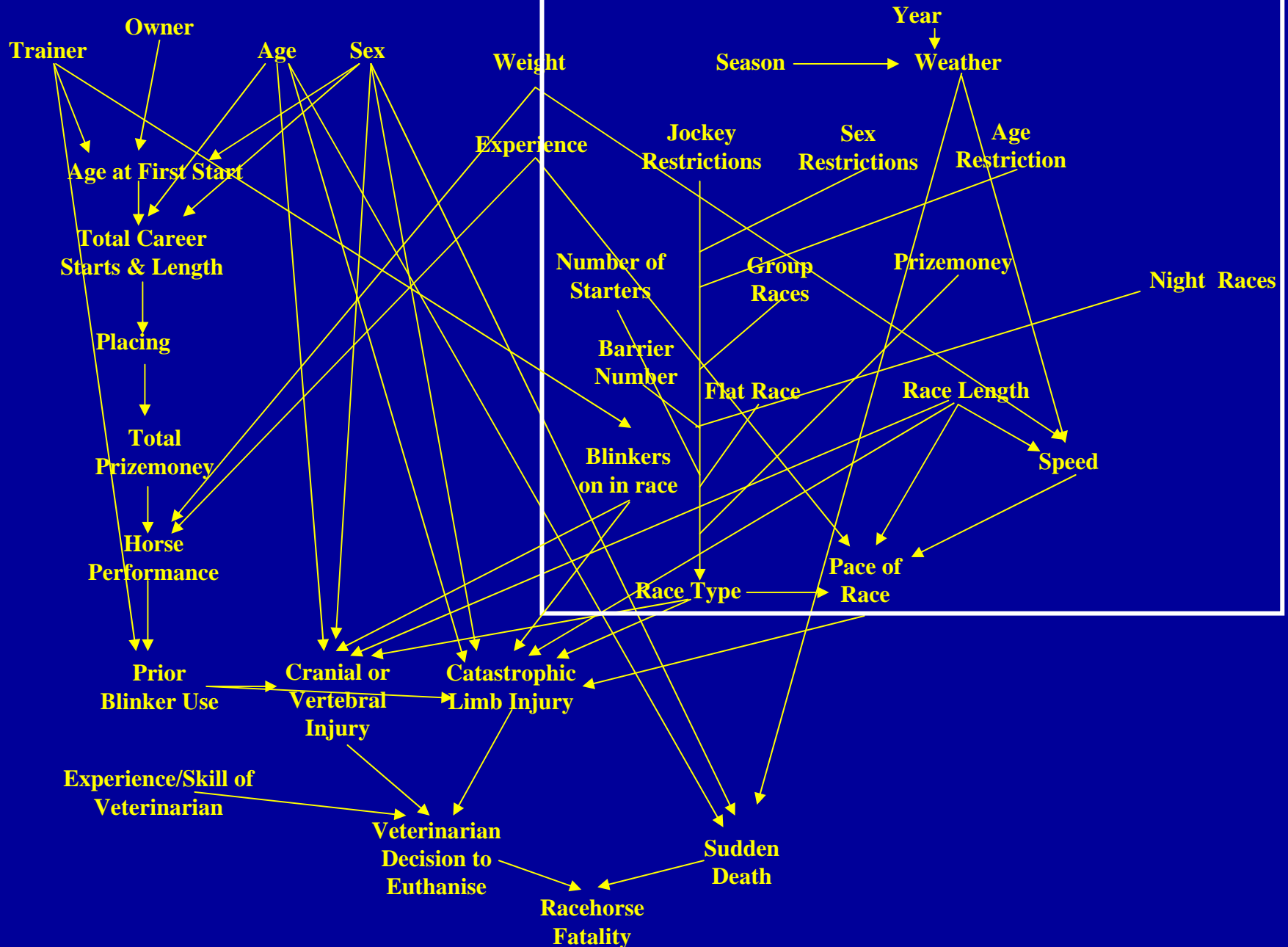
- Year/month
- Group race
- Age restriction
- Weight type
- Sex restriction
- Number of starters
- Barrier number
- Event length
- Night race
- Blinkers on in race



# HORSE

# JOCKEY

# RACE



# Track Factors

- Length of circuit (metres)
- Length of straight (metres)
- Going of the track (heavy, dead, good, fast)
- Racecourse location (city or country)

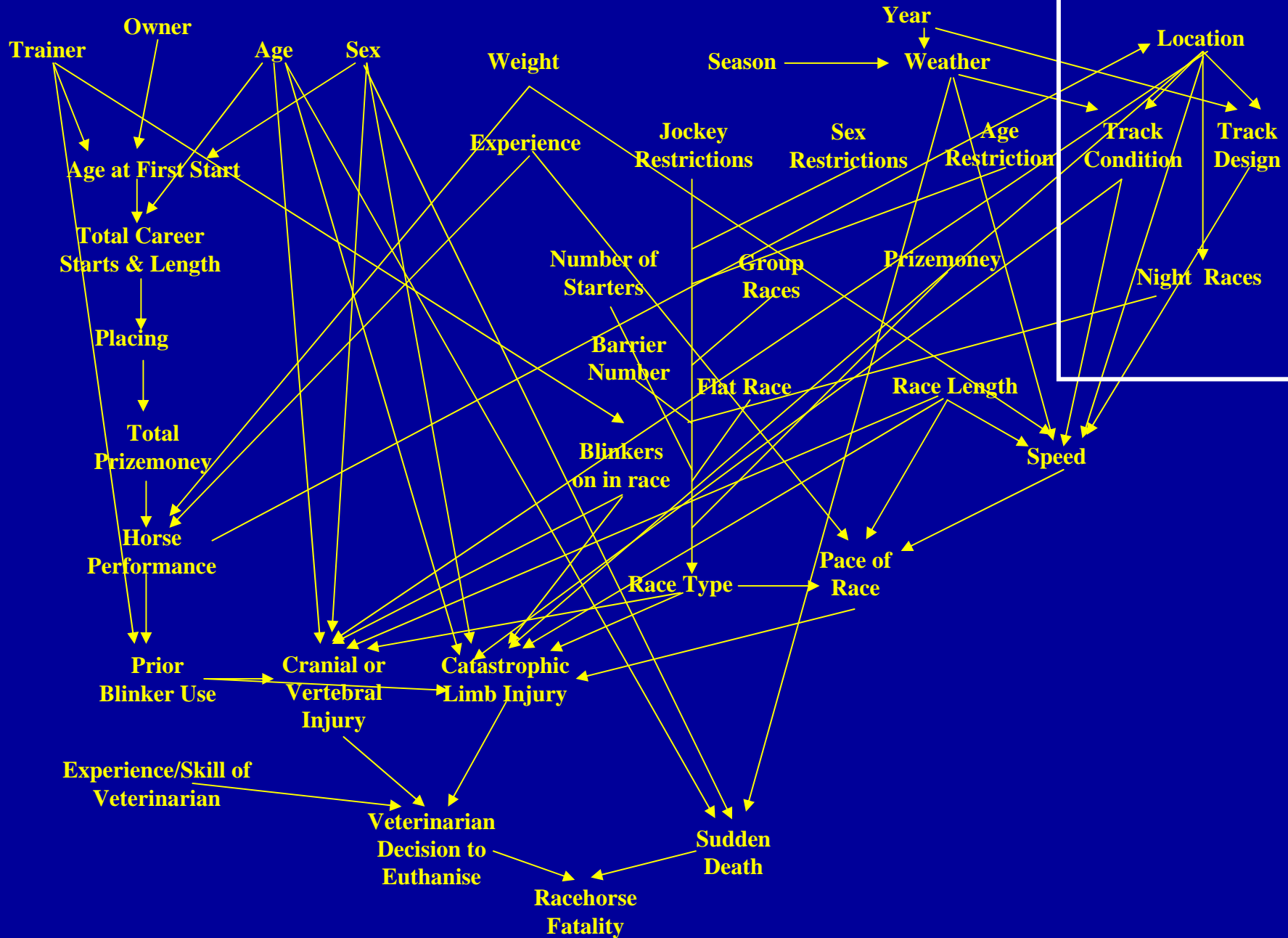


# HORSE

# JOCKEY

# RACE

# TRACK



# Univariate Screening ( $p$ value $< 0.25$ )

## Continuous Variables

- Age (years)
- Career length (years)
- Year of race
- Length of race (per hundred metres)
- Speed of race

# Univariate Screening ( $p$ value $< 0.25$ )

## Categorical Variables

- Sex restriction of race
- Sex of horse
- Group race
- Number of starters
- Month of race
- Going of the track
- Location of racecourse
- Length of circuit
- Blinkers in race
- Night race

# Model Building

- Forward stepwise selection ( $p_e < 0.05$ ,  $p_r > 0.10$ )
- Backward stepwise selection ( $p_e < 0.05$ ,  $p_r > 0.10$ )
- Stata Statistical Software: Release 8.2, StataCorp. 2003
- Receiver Operator Characteristic Curve
- Hosmer-Lemeshow Goodness of Fit Test

# Clustering

- Intra class correlation coefficient (ICC)
  - how observations within a cluster are correlated
- Perfect correlation (upper limit) = 1
- No correlation = 0

# Clustering

- Horse 1.06 starts per horse, ICC = 0
- Track 55 starts per track, ICC = 0
- Jockey 6 starts per jockey, ICC = 0
- Trainer 2.8 starts per trainer, ICC = 0.028

# Variance Inflation Factor

- $VIF = 1 + (m - 1) ICC$ , where  $m$  = the average number of observations per cluster
- No clustering if  $VIF = 1$
- Horse  $VIF = 1$
- Track  $VIF = 1$
- Jockey  $VIF = 1$
- Trainer  $VIF = 1.05$

# Final Model

- Gender
- Racecourse location
- Race length
- Blinkers in race
- Year of race
- Going of track



# Horse Gender

- Increased odds of fatality for male horses (geldings, stallions) compared with female horses
- OR 1.6 (95% CI 1.2-2.0)



# Racecourse Location

- Increased odds of fatality on city racecourses compared with country racecourses
- OR 1.6 (95% CI 1.2-2.1)



# Race Length

- Increased odds of fatality for every extra hundred metres of race length
- OR 1.04 (95% CI 1.01-1.07)



# Blinkers

- Increased odds of fatality for wearing blinkers in a race compared with no blinkers
- OR 1.3 (95% CI 1.0-1.7)



# Year of Race

- Increased odds of fatality for each extra year of duration of the study
- OR 1.05 (95% CI 1.02-1.08)



# Going of Track

- Increased odds of fatality for fast or good tracks compared with slow, heavy or dead tracks
- OR 1.7 (95% CI 1.3-2.2)

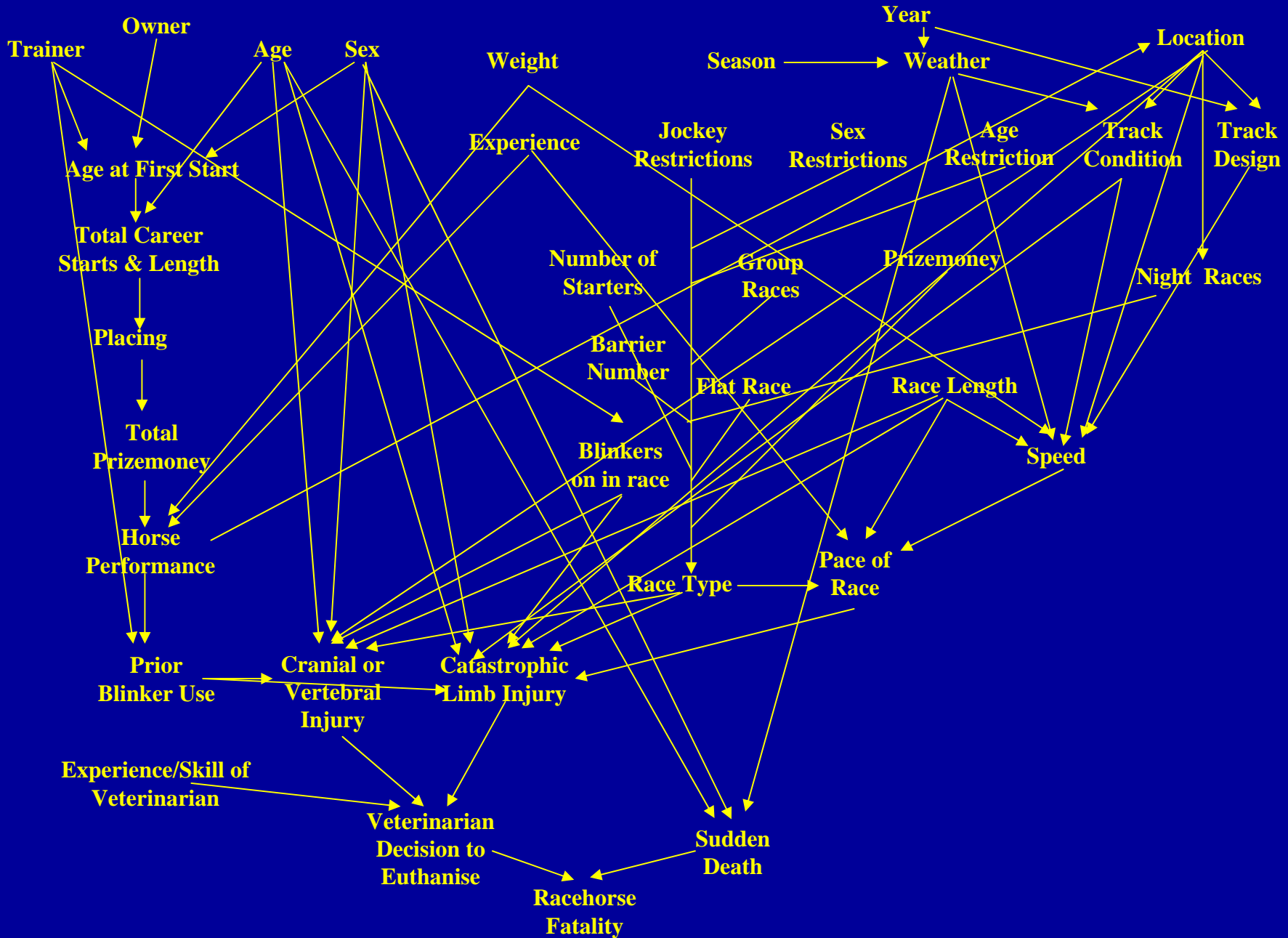


# HORSE

# JOCKEY

# RACE

# TRACK

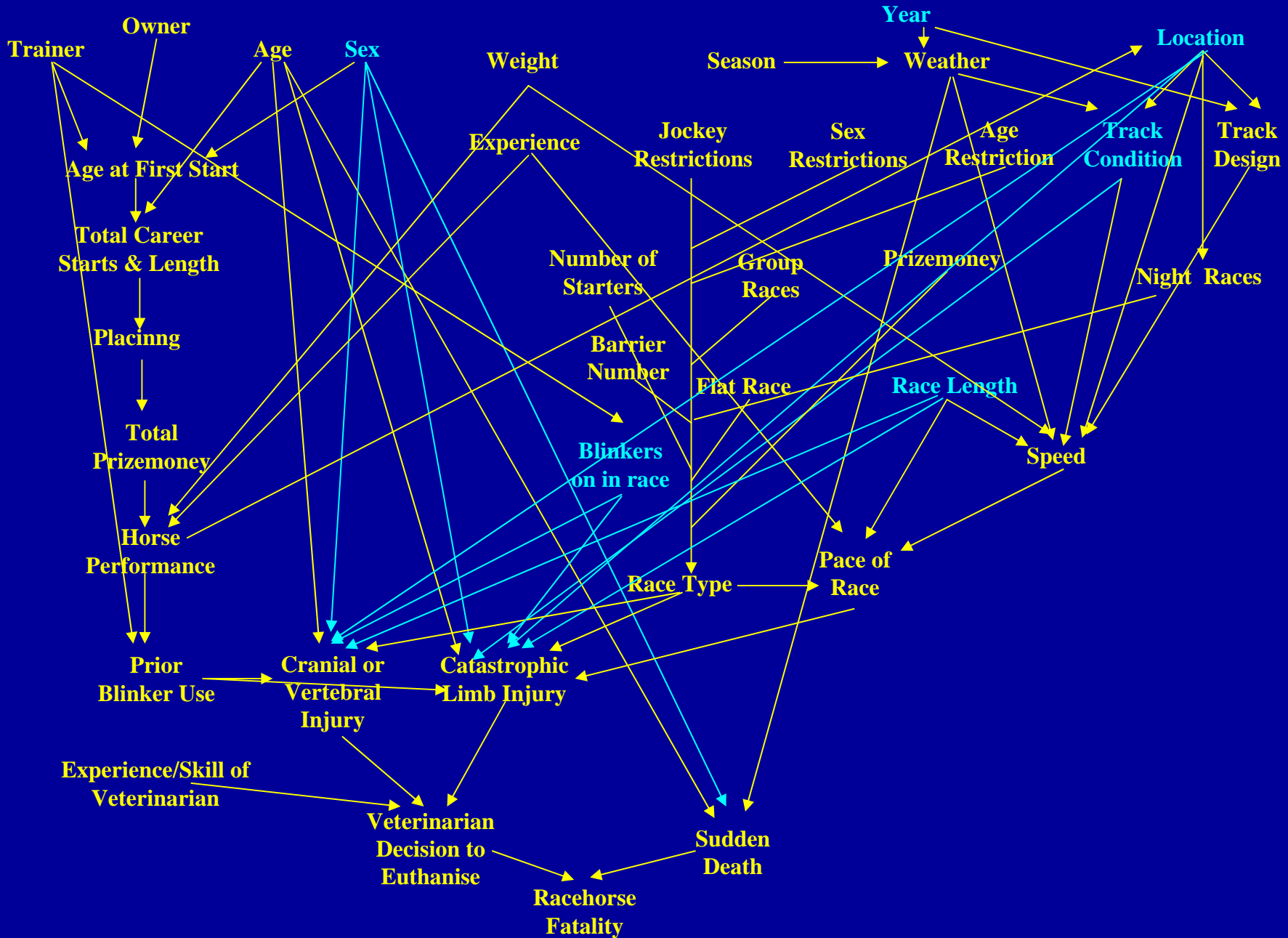


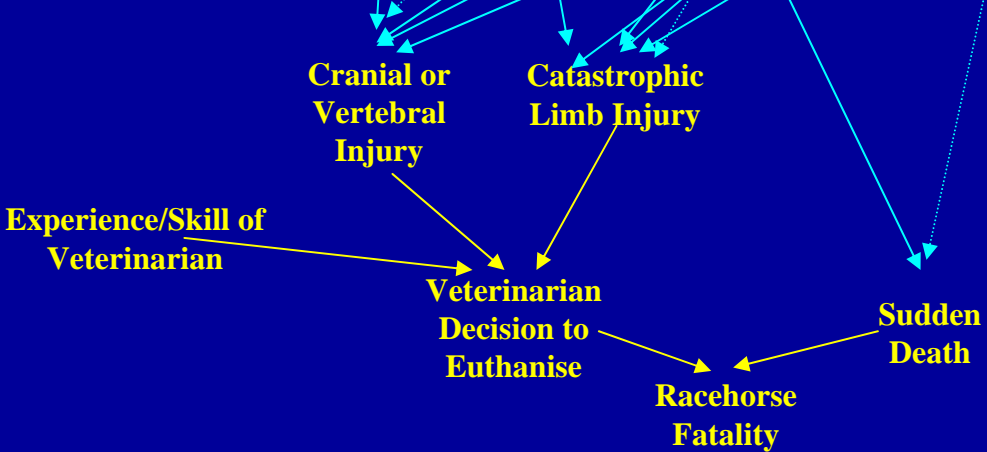
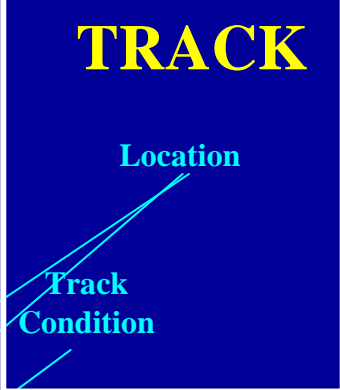
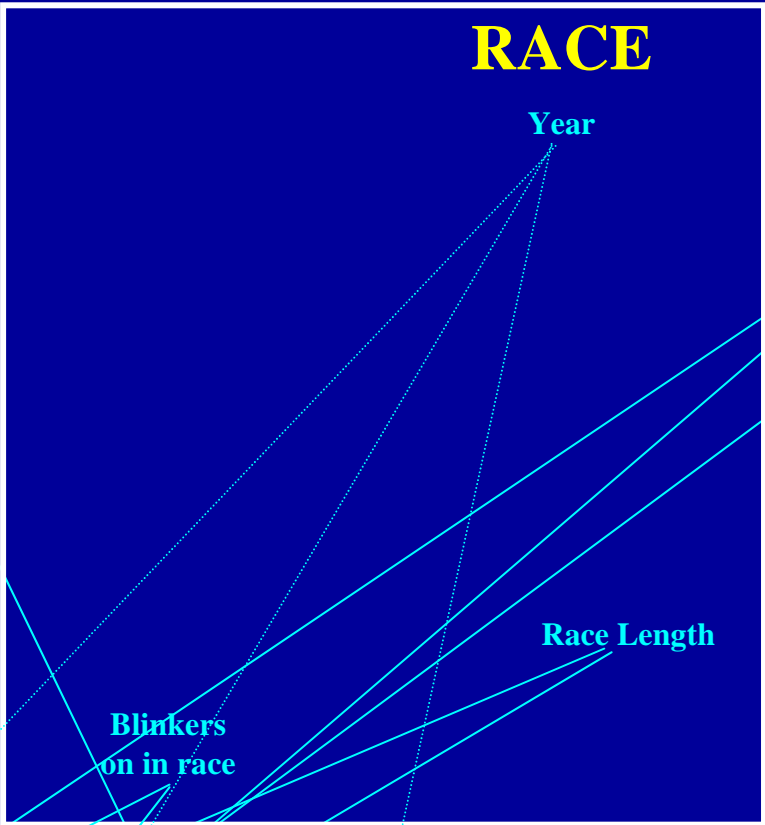
# HORSE

# JOCKEY

# RACE

# TRACK



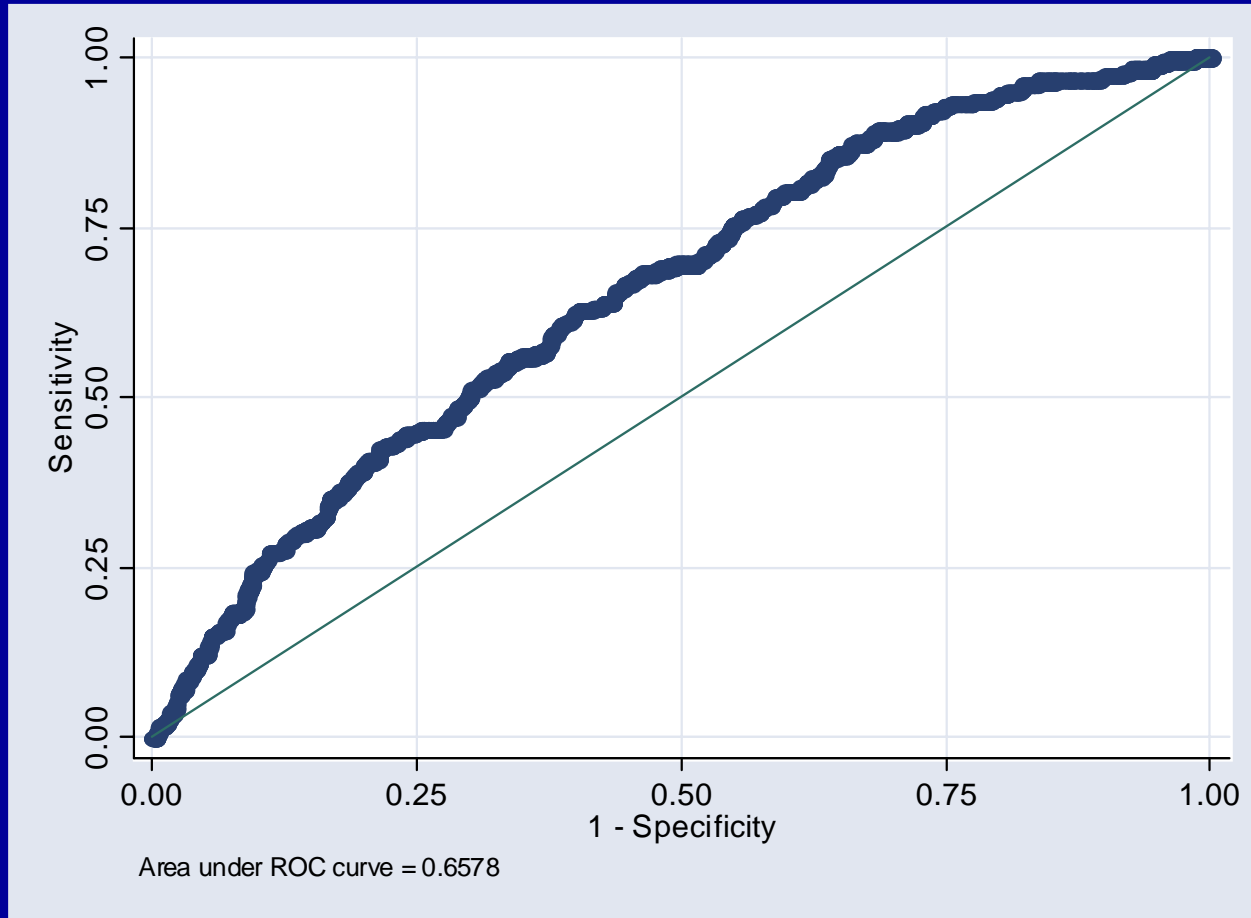


# Fit of Model

Receiver Operating Characteristic Curve

Hosmer-Lemeshow Goodness of Fit Test

# Receiver Operating Characteristic Curve



Area under curve = 0.66

# Hosmer-Lemeshow Goodness of Fit Test

Significance of test statistic  $p = 0.34$

No evidence of lack of fit

# Completion of Existing Model

- Assess influential covariate patterns
  - deviance statistics to look for outliers and high leverage
- Assess confounding
- Assess interaction
- Assess functional forms of continuous covariates

# Future Directions

- Further investigation of risk factors
  - pace of race
  - rate of accumulation of starts in career
  - length of time since last spell



# Future Directions

- Refine case definition
  - catastrophic limb injuries
  - lateral condylar fractures



# Future Directions

- Study of risk factors for fatality in jumps races in Victoria



# Significance of Study

- Use of fatalities from flat races on both country and city tracks and a refined case definition have enabled identification of alternative risk factors to those reported in the two previous Australian studies.

## Significance of Study

- Assuming causality, 64% of all Thoroughbred racehorse fatalities in Victoria are attributable to flat racing.
- Strategies to reduce the risk of fatality in flat races in Victoria need to focus on the risk factors identified in this study.



# Acknowledgements

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