Supplement 1

Pain sites

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Contents

Import and check data

```
# Import
data <- read_rds('data-cleaned/data-pain-sites.rds')
demo <- read_rds('data-cleaned/data-demographics.rds')

# Check
```

```r
## Pain sites
dim(data)
```

```
## [1] 598  21
```

```r
names(data)
```

```
##  [1] "ID"                "Head"              "Throat"
##  [4] "Shoulder"          "Arms"              "Elbows"
##  [7] "Wrists.Hands"      "Chest"             "Upper_back"
## [10] "Lower_back"        "Abdomen"           "Cervical_spine"
## [13] "Thoracic_spine"    "Lumbosacral_spine" "Groin"
## [16] "Hips"              "Legs"              "Knees"
## [19] "Ankles.Feet"       "Buttocks"          "Whole_body"
```

```r
glimpse(data)
```

```
## Rows: 598
## Columns: 21
## $ ID                <chr> "RPB73", "RPB74", "RPB75", "RPB76", "RPB77", "RPB...
## $ Head              <chr> "No", "No", "No", "Yes", "Yes", "No", "No", "No",...
## $ Throat            <chr> "No", "No", "No", "No", "No", "No", "No", "No", "...
## $ Shoulder          <chr> "No", "No", "No", "No", "No", "No", "No", "No", "...
## $ Arms              <chr> "No", "No", "No", "No", "No", "No", "No", "No", "...
## $ Elbows            <chr> "No", "No", "No", "No", "No", "No", "No", "No", "...
## $ Wrists.Hands      <chr> "No", "No", "No", "No", "No", "No", "No", "No", "...
## $ Chest             <chr> "No", "No", "No", "Yes", "No", "No", "No", "No", ...
## $ Upper_back        <chr> "No", "No", "No", "No", "No", "No", "No", "No", "...
## $ Lower_back        <chr> "No", "No", "No", "No", "No", "No", "No", "No", "...
## $ Abdomen           <chr> "No", "No", "Yes", "Yes", "No", "No", "Yes", "No"...
## $ Cervical_spine    <chr> "No", "No", "No", "No", "No", "No", "No", "No", "...
## $ Thoracic_spine    <chr> "No", "No", "No", "No", "No", "No", "No", "No", "...
## $ Lumbosacral_spine <chr> "No", "No", "No", "No", "No", "No", "No", "No", "...
## $ Groin             <chr> "No", "No", "No", "No", "No", "No", "No", "No", "...
## $ Hips              <chr> "No", "No", "No", "No", "No", "No", "No", "Yes", ...
## $ Legs              <chr> "No", "No", "No", "No", "No", "Yes", "No", "Yes",...
## $ Knees             <chr> "No", "No", "No", "No", "No", "Yes", "No", "Yes",...
## $ Ankles.Feet       <chr> "No", "No", "No", "No", "No", "Yes", "No", "Yes",...
## $ Buttocks          <chr> "No", "No", "No", "No", "No", "No", "No", "Yes", ...
## $ Whole_body        <chr> "No", "No", "No", "No", "Yes", "No", "No", "No", ...
```

```r
## Demographics
dim(demo)
```

```
## [1] 598  14
```

```r
names(demo)
```

```
##  [1] "ID"
##  [2] "Sex"
##  [3] "Age"
##  [4] "Language"
##  [5] "Education (choice=Primary ( grades 1-7))"
##  [6] "Education (choice=secondary (grades 8-12))"
##  [7] "Education (choice=Tertiary (any post-school))"
##  [8] "Education (choice=Missing)"
##  [9] "Employment_status"
```

```
## [10] "CD4_recent"
## [11] "ART_currently"
## [12] "ART_D4T.now"
## [13] "ART_D4T.previous"
## [14] "TB"
```

```
glimpse(demo)
```

```
## Rows: 598
## Columns: 14
## $ ID                                                  <chr> "RPB73", "RPB74", "...
## $ Sex                                                 <chr> "Female", "Female",...
## $ Age                                                 <dbl> 36, 27, 39, 36, 31,...
## $ Language                                            <chr> "Xhosa", "Xhosa", "...
## $ `Education (choice=Primary ( grades 1-7))`          <chr> "Unchecked", "Unche...
## $ `Education (choice=secondary (grades 8-12))`        <chr> "Unchecked", "Check...
## $ `Education (choice=Tertiary (any post-school))`     <chr> "Checked", "Uncheck...
## $ `Education (choice=Missing)`                        <chr> "Unchecked", "Unche...
## $ Employment_status                                   <chr> "Other", "Unemploye...
## $ CD4_recent                                          <dbl> 391, 571, 591, 207,...
## $ ART_currently                                       <chr> "Yes", "Yes", "Yes"...
## $ ART_D4T.now                                         <chr> "No", "Yes", "No", ...
## $ ART_D4T.previous                                    <chr> "No", "No", "No", "...
## $ TB                                                  <chr> "No", "No", "No", "...
```

Basic descriptive statistics

Pain sites

```
data %>%
    mutate_if(is.character, factor) %>%
    skim()
```

Table 1: Data summary

Name	Piped data
Number of rows	598
Number of columns	21
Column type frequency:	
factor	21
Group variables	None

Variable type: factor

skim_variable	n_missing	complete_rate	ordered	n_unique	top_counts
ID	0	1	FALSE	598	DD1: 1, DD1: 1, DD1: 1, DD1: 1
Head	0	1	FALSE	2	No: 403, Yes: 195

skim_variable	n_missing	complete_rate	ordered	n_unique	top_counts
Throat	0	1	FALSE	2	No: 579, Yes: 19
Shoulder	0	1	FALSE	2	No: 550, Yes: 48
Arms	0	1	FALSE	2	No: 573, Yes: 25
Elbows	0	1	FALSE	2	No: 576, Yes: 22
Wrists.Hands	0	1	FALSE	2	No: 563, Yes: 35
Chest	0	1	FALSE	2	No: 481, Yes: 117
Upper_back	0	1	FALSE	1	No: 598
Lower_back	0	1	FALSE	2	No: 555, Yes: 43
Abdomen	0	1	FALSE	2	No: 437, Yes: 161
Cervical_spine	0	1	FALSE	2	No: 568, Yes: 30
Thoracic_spine	0	1	FALSE	2	No: 523, Yes: 75
Lumbosacral_spine	0	1	FALSE	2	No: 506, Yes: 92
Groin	0	1	FALSE	2	No: 544, Yes: 54
Hips	0	1	FALSE	2	No: 558, Yes: 40
Legs	0	1	FALSE	2	No: 499, Yes: 99
Knees	0	1	FALSE	2	No: 514, Yes: 84
Ankles.Feet	0	1	FALSE	2	No: 414, Yes: 184
Buttocks	0	1	FALSE	2	No: 579, Yes: 19
Whole_body	0	1	FALSE	2	No: 584, Yes: 14

Demographics

```
demo %>%
    mutate_if(is.character, factor) %>%
    skim()
```

Table 3: Data summary

Name	Piped data
Number of rows	598
Number of columns	14
_____	
Column type frequency:	
factor	12
numeric	2
_____	
Group variables	None

Variable type: factor

skim_variable	n_missing	complete_rate	ordered	n_unique	top_counts
ID	0	1.00	FALSE	598	DD1: 1, DD1: 1, DD1:
Sex	0	1.00	FALSE	2	Fem: 482, Mal: 116
Language	2	1.00	FALSE	12	Xho: 175, Zul: 175, Ts
Education (choice=Primary (grades 1-7))	0	1.00	FALSE	2	Unc: 497, Che: 101
Education (choice=secondary (grades 8-12))	0	1.00	FALSE	2	Che: 396, Unc: 202
Education (choice=Tertiary (any post-school))	0	1.00	FALSE	2	Unc: 529, Che: 69
Education (choice=Missing)	0	1.00	FALSE	2	Unc: 573, Che: 25

skim_variable	n_missing	complete_rate	ordered	n_unique	top_counts
Employment_status	0	1.00	FALSE	5	Une: 330, Emp: 131,
ART_currently	5	0.99	FALSE	2	Yes: 462, No: 131
ART_D4T.now	3	0.99	FALSE	3	No: 383, Mis: 153, Ye
ART_D4T.previous	2	1.00	FALSE	3	No: 310, Mis: 233, Ye
TB	2	1.00	FALSE	3	No: 258, Mis: 227, Ye

Variable type: numeric

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100	hist
Age	8	0.99	37.29	9.06	19	31	36	42.0	76	□ □ □ □ □
CD4_recent	99	0.83	338.06	400.04	1	155	262	438.5	7300	□ □ □ □ □

Boostrap functions

```
# Proportion
prop_func <- function(d, i){
    dat <- d[i, ]
    dat_vec <- dat[[1]]
    dat_prop <- mean(dat_vec == 'Yes')
    dat_prop
}

# Median
median_func <- function(d, i){
    dat <- d[i, ]
    dat_vec <- dat[[1]]
    dat_median <- median(dat_vec)
    dat_median
}
```

Proportion point estimates with 95% CIs

Process data

```
# Remove ID and Whole_body column
prop <- data[, !(names(data) %in% c('ID', 'Whole_body'))]

# Bootstrap CIs
prop_boot <- prop %>%
    # Pivot to long format
    pivot_longer(cols = everything(),
                 names_to = 'site',
                 values_to = 'pain_present') %>%
    # Add body regions
```

```
    mutate(region = case_when(
        site == 'Chest' |
            site == 'Head' |
            site == 'Throat' |
            site == 'Upper_back' |
            site == 'Shoulder' ~ 'Head and upper torso',
        site == 'Lower_back' |
            site == 'Abdomen' |
            site == 'Hips' |
            site == 'Buttocks' |
            site == 'Groin' ~ 'Lower torso',
        site == 'Legs' |
            site == 'Knees' |
            site == 'Ankles.Feet' ~ 'Lower limbs',
        site == 'Arms' |
            site == 'Elbows' |
            site == 'Wrists.Hands' ~ 'Upper limbs',
        site == 'Cervical_spine' |
            site == 'Thoracic_spine' |
            site == 'Lumbosacral_spine' ~ 'Spinal column',
        TRUE ~ 'other'
    )) %>%
    # Nest by body region and body site
    group_by(region, site) %>%
    nest() %>%
    # Boostrap data
    mutate(boot = map(.x = data,
                      ~ boot(data = .x,
                             statistic = prop_func,
                             R = 999,
                             stype = 'i'))) %>%
    # Get CI
    mutate(ci = map(.x = boot,
                    ~ boot.ci(.x, type = 'perc'))) %>%
    # Extract ci data
    mutate(point_est = map(.x = ci,
                           ~ .x$t0),
           lower_ci = map(.x = ci,
                          ~ .x$percent[[4]]),
           upper_ci = map(.x = ci,
                          ~ .x$percent[[5]])) %>%
    # Remove columns
    select(-data, -boot, -ci) %>%
    # Unnest
    unnest(cols = c(point_est, lower_ci, upper_ci))

# Re-nest by body region and generate figures and tables
prop_boot2 <- prop_boot %>%
    group_by(region) %>%
    nest() %>%
    # Fix site labels
    mutate(data = map(.x = data,
                      ~ .x %>%
```

```
                        mutate(site = str_replace_all(site,
                                                      pattern = '_',
                                                      replacement = ' '),
                               site = str_replace_all(site,
                                                      pattern = '\\.',
                                                      replacement = ' & '))) %>%
    # Re-order sites by point_est
    mutate(data = map(.x = data,
                      ~ .x %>%
                        mutate(site = fct_reorder(site,
                                                  point_est)))) %>%
    # Plot data
    mutate(plots = map2(.x = data,
                        .y = region,
                        ~ .x %>%
                          ggplot(data = .) +
                          aes(x = site,
                              y = point_est,
                              ymin = lower_ci,
                              ymax = upper_ci) +
                          geom_linerange(size = 1) +
                          geom_point(size = 6) +
                          coord_flip() +
                           labs(title = .y,
                                subtitle = '(Point estimate with 95%CI)',
                                y = 'Proportion with pain') +
                           scale_y_continuous(limits = c(0, 1)) +
                           theme_minimal(base_size = 18) +
                           theme(plot.title = element_text(size = 18),
                                 plot.subtitle = element_text(size = 12),
                                 axis.title.y = element_blank(),
                                 panel.grid = element_blank(),
                                 axis.text = element_text(colour = '#000000'),
                                 axis.line = element_line(size = 0.5),
                                 axis.ticks = element_line(size = 0.5)))) %>%
    # Tabulate data
    mutate(tables = map2(.x = data,
                         .y = region,
                         ~ .x %>%
                           kable(caption = .y,
                                 digits = 2)))
```

Tabulated proportions (with 95% CIs), by body region

```
walk(prop_boot2$tables, ~ print(.x))
```

Table 6: Head and upper torso

site	point_est	lower_ci	upper_ci
Head	0.33	0.29	0.36
Throat	0.03	0.02	0.05

site	point_est	lower_ci	upper_ci
Shoulder	0.08	0.06	0.10
Chest	0.20	0.17	0.23
Upper back	0.00	0.00	0.00

Table 7: Upper limbs

site	point_est	lower_ci	upper_ci
Arms	0.04	0.03	0.06
Elbows	0.04	0.02	0.05
Wrists & Hands	0.06	0.04	0.08

Table 8: Lower torso

site	point_est	lower_ci	upper_ci
Lower back	0.07	0.05	0.10
Abdomen	0.27	0.23	0.31
Groin	0.09	0.07	0.11
Hips	0.07	0.05	0.09
Buttocks	0.03	0.02	0.05

Table 9: Spinal column

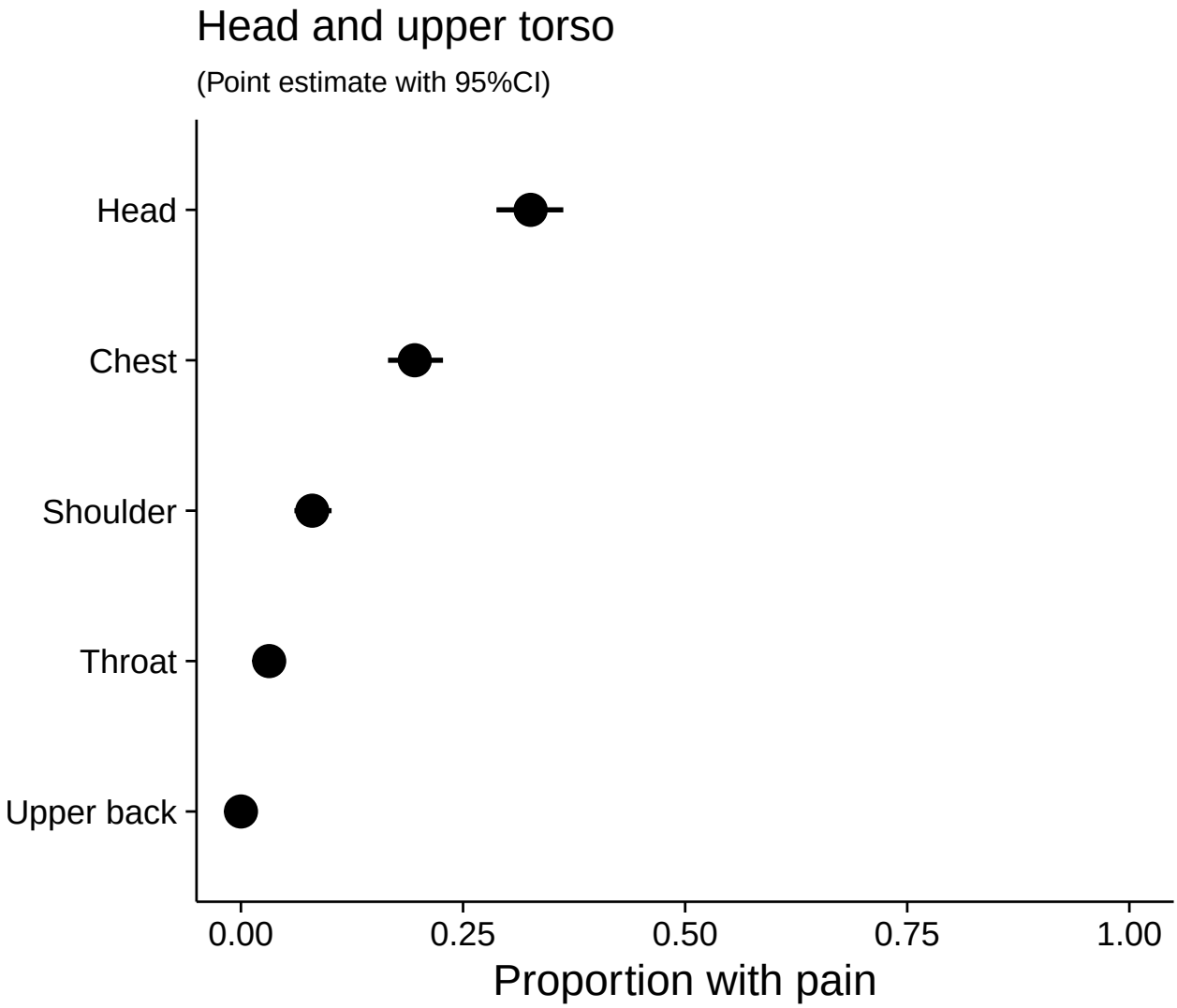
site	point_est	lower_ci	upper_ci
Cervical spine	0.05	0.03	0.07
Thoracic spine	0.13	0.10	0.15
Lumbosacral spine	0.15	0.13	0.19

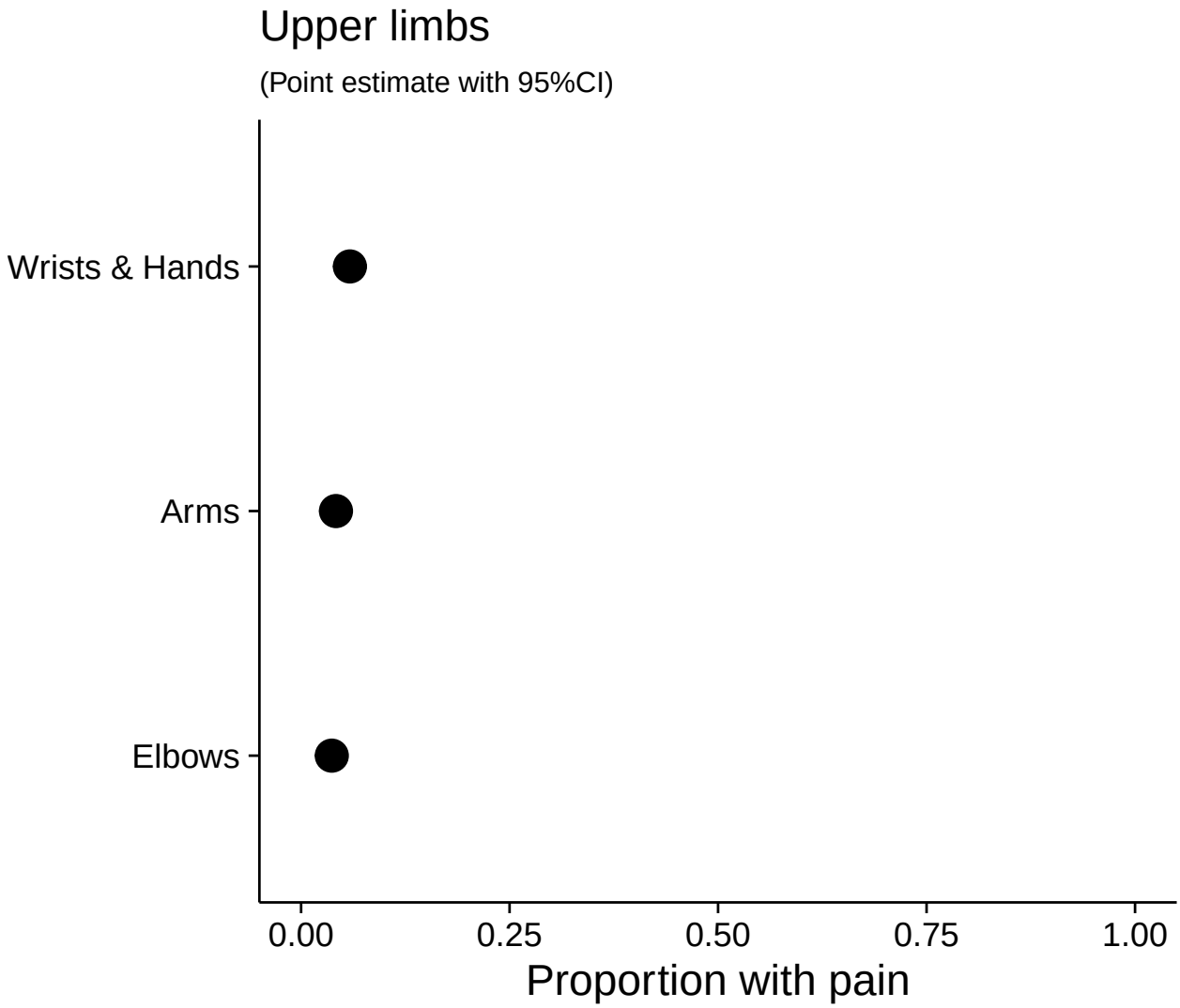
Table 10: Lower limbs

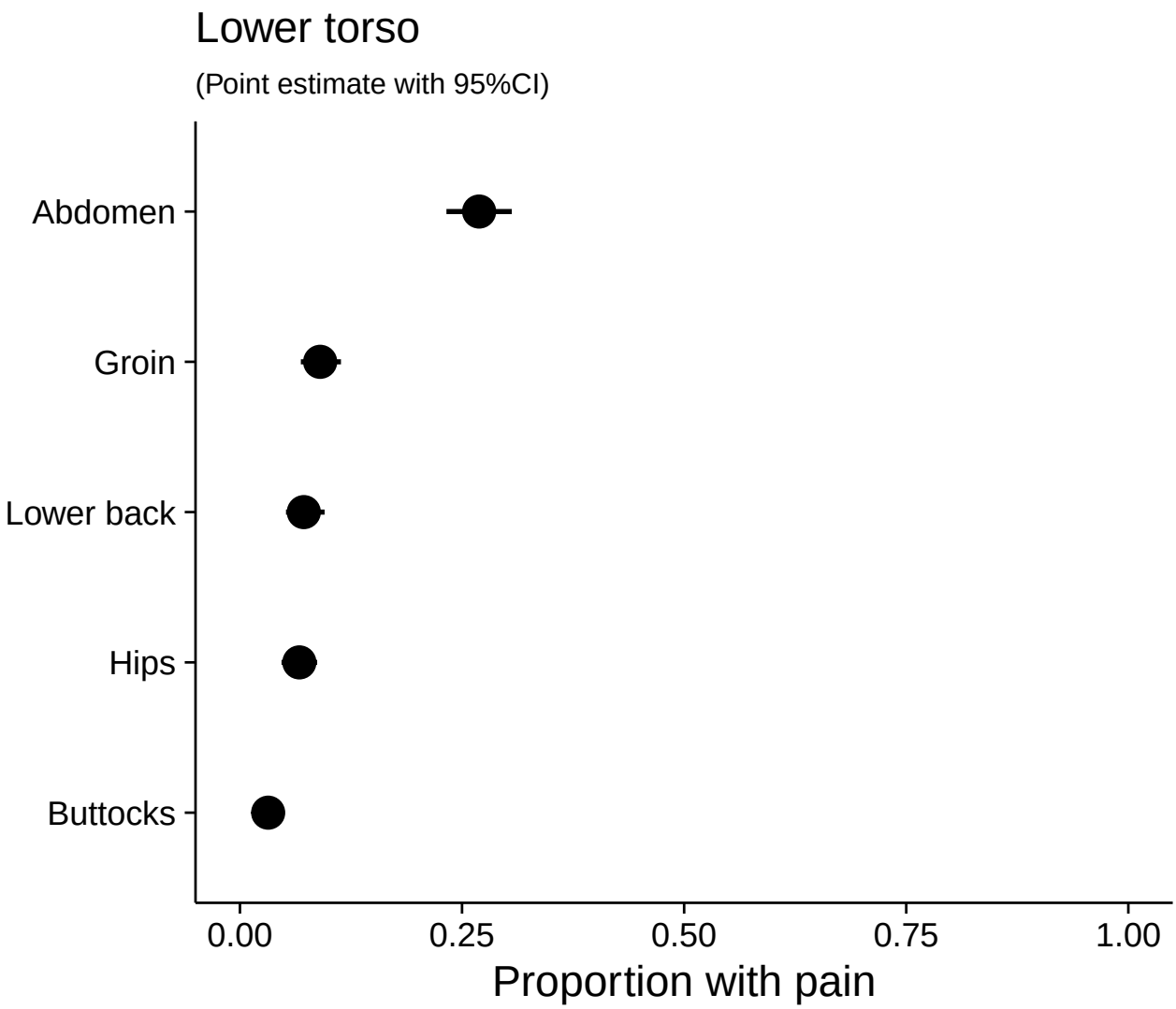
site	point_est	lower_ci	upper_ci
Legs	0.17	0.14	0.20
Knees	0.14	0.11	0.17
Ankles & Feet	0.31	0.27	0.35

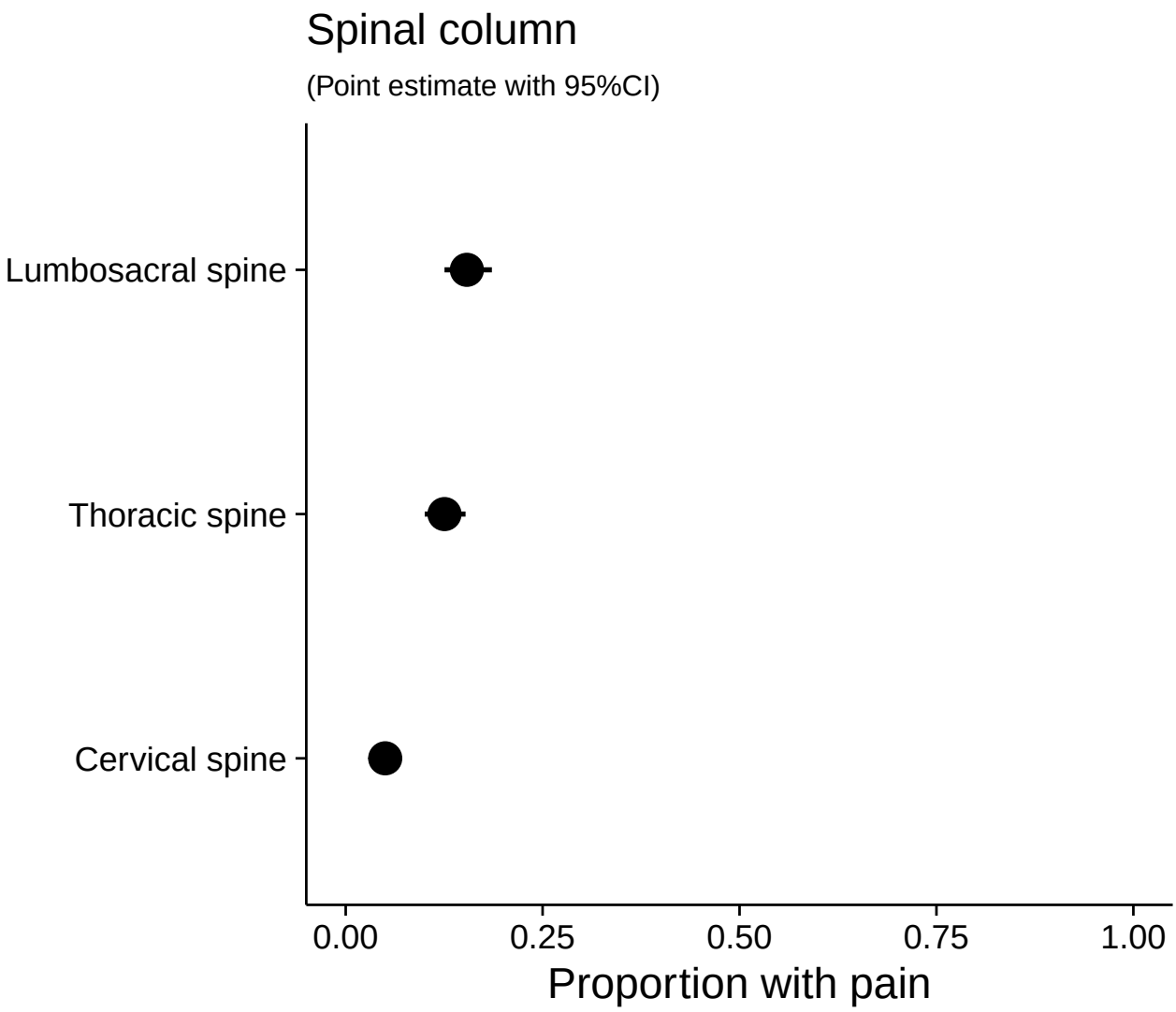
Plotted proportions (with 95% CIs), by body region

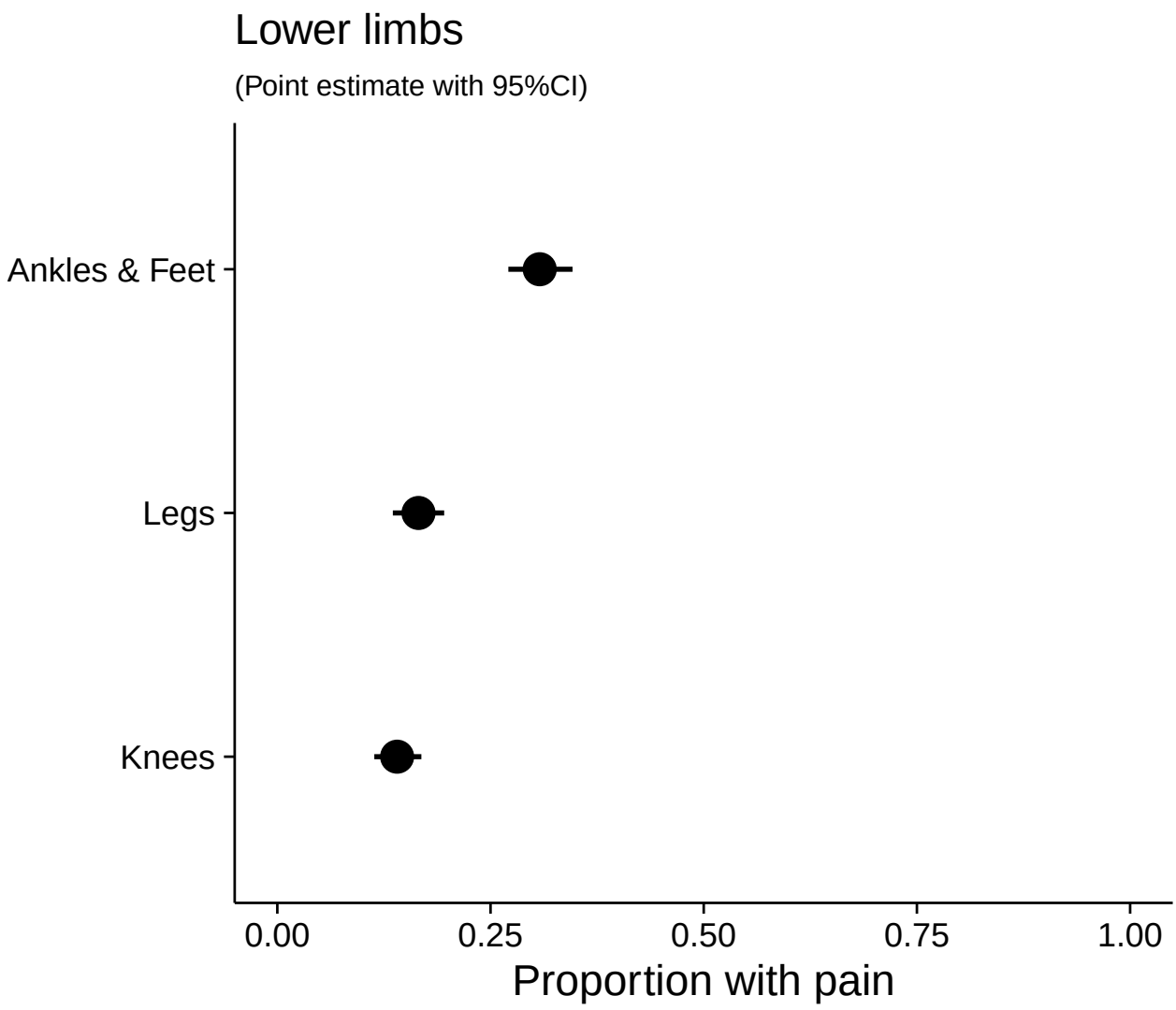
```
walk(prop_boot2$plots, ~ print(.x))
```


Head and upper torso
(Point estimate with 95%CI)
Head
Chest
Shoulder
Throat
Upper back
0.00
0.25
0.50
0.75
1.00
Proportion with pain


Upper limbs
(Point estimate with 95%CI)
Wrists & Hands
Arms
Elbows
0.00
0.25
0.50
0.75
1.00
Proportion with pain


Lower torso
(Point estimate with 95%CI)
Abdomen
Groin
Lower back
Hips
Buttocks
0.00
0.25
0.50
0.75
1.00
Proportion with pain


Spinal column
(Point estimate with 95%CI)
Lumbosacral spine
Thoracic spine
Cervical spine
0.00
0.25
0.50
0.75
1.00
Proportion with pain



By sex

Process data

```
# Select sex data
sex <- demo[, c('ID', 'Sex')]

# Join to boot_data & remove ID, Whole_body, and Upper_back
sex <- left_join(data, sex) %>%
    select(-ID, -Whole_body, -Upper_back)

# Bootstrap CIs
sex_boot <- sex %>%
    # Pivot to long format
    pivot_longer(cols = -Sex,
```

```
                names_to = 'site',
                values_to = 'pain_present') %>%
    # Add body regions
    mutate(region = case_when(
        site == 'Chest' |
            site == 'Head' |
            site == 'Throat' |
            site == 'Upper_back' |
            site == 'Shoulder' ~ 'Head and upper torso',
        site == 'Lower_back' |
            site == 'Abdomen' |
            site == 'Hips' |
            site == 'Buttocks' |
            site == 'Groin' ~ 'Lower torso',
        site == 'Legs' |
            site == 'Knees' |
            site == 'Ankles.Feet' ~ 'Lower limbs',
        site == 'Arms' |
            site == 'Elbows' |
            site == 'Wrists.Hands' ~ 'Upper limbs',
        site == 'Cervical_spine' |
            site == 'Thoracic_spine' |
            site == 'Lumbosacral_spine' ~ 'Spinal column',
        TRUE ~ 'other'
    )) %>%
    # Nest by body region and body site
    group_by(Sex, region, site) %>%
    nest() %>%
    # Boostrap data
    mutate(boot = map(.x = data,
                      ~ boot(data = .x,
                             statistic = prop_func,
                             R = 999,
                             stype = 'i'))) %>%
    # Get CI
    mutate(ci = map(.x = boot,
                    ~ boot.ci(.x, type = 'perc'))) %>%
    # Extract ci data
    mutate(point_est = map(.x = ci,
                           ~ .x$t0),
           lower_ci = map(.x = ci,
                          ~ .x$percent[[4]]),
           upper_ci = map(.x = ci,
                          ~ .x$percent[[5]])) %>%
    # Remove columns
    select(-data, -boot, -ci) %>%
    # Unnest
    unnest(cols = c(point_est, lower_ci, upper_ci))

# Re-nest by body region and generate figures and tables
sex_boot2 <- sex_boot %>%
    group_by(region) %>%
    nest() %>%
```

```
    # Fix site labels
    mutate(data = map(.x = data,
                      ~ .x %>%
                          mutate(site = str_replace_all(site,
                                                        pattern = '_',
                                                        replacement = ' '),
                                 site = str_replace_all(site,
                                                        pattern = '\\.',
                                                        replacement = ' & ')))) %>%
    # Re-order sites by point_est
    mutate(data = map(.x = data,
                      ~ .x %>%
                          mutate(site = fct_reorder(site,
                                                    point_est)))) %>%
    # Plot data
    mutate(plots = map2(.x = data,
                        .y = region,
                        ~ .x %>%
                            ggplot(data = .) +
                            aes(x = site,
                                y = point_est,
                                ymin = lower_ci,
                                ymax = upper_ci,
                                fill = Sex) +
                            geom_linerange(position = position_dodge2(width = 0.6),
                                           size = 1,
                                           colour = '#000000') +
                            geom_point(shape = 21,
                                       colour = '#000000',
                                       position = position_dodge2(width = 0.6),
                                       size = 6,
                                       stroke = 1) +
                            coord_flip() +
                            labs(title = .y,
                                 subtitle = '(Point estimate with 95%CI)',
                                 y = 'Proportion with pain') +
                            scale_y_continuous(limits = c(0, 1)) +
                            scale_fill_manual(values = c('#000000', '#FFFFFF')) +
                            theme_minimal(base_size = 18) +
                            theme(plot.title = element_text(size = 18),
                                  plot.subtitle = element_text(size = 12),
                                  legend.title = element_blank(),
                                  legend.position = 'top',
                                  axis.title.y = element_blank(),
                                  panel.grid = element_blank(),
                                  axis.text = element_text(colour = '#000000'),
                                  axis.line = element_line(size = 0.5),
                                  axis.ticks = element_line(size = 0.5)))) %>%
    # Tabulate data
    mutate(tables = map2(.x = data,
                         .y = region,
                         ~ .x %>%
                             kable(caption = .y,
```

```
                                digits = 2)))
```

Tabulated proportions (with 95% CIs), by age and body region

```
walk(sex_boot2$tables, ~ print(.x))
```

Table 11: Head and upper torso

Sex	site	point_est	lower_ci	upper_ci
Female	Head	0.38	0.33	0.42
Female	Throat	0.03	0.01	0.04
Female	Shoulder	0.07	0.05	0.10
Female	Chest	0.20	0.16	0.23
Male	Head	0.12	0.06	0.18
Male	Throat	0.04	0.01	0.09
Male	Shoulder	0.12	0.07	0.18
Male	Chest	0.20	0.13	0.27

Table 12: Upper limbs

Sex	site	point_est	lower_ci	upper_ci
Female	Arms	0.04	0.03	0.06
Female	Elbows	0.03	0.02	0.05
Female	Wrists & Hands	0.06	0.04	0.09
Male	Arms	0.03	0.01	0.07
Male	Elbows	0.05	0.02	0.09
Male	Wrists & Hands	0.03	0.01	0.07

Table 13: Lower torso

Sex	site	point_est	lower_ci	upper_ci
Female	Lower back	0.07	0.05	0.10
Female	Abdomen	0.29	0.25	0.33
Female	Groin	0.10	0.07	0.12
Female	Hips	0.06	0.04	0.08
Female	Buttocks	0.03	0.01	0.05
Male	Lower back	0.06	0.02	0.10
Male	Abdomen	0.20	0.13	0.28
Male	Groin	0.07	0.03	0.12
Male	Hips	0.09	0.04	0.16
Male	Buttocks	0.04	0.01	0.09

Table 14: Spinal column

Sex	site	point_est	lower_ci	upper_ci
Female	Cervical spine	0.06	0.04	0.08

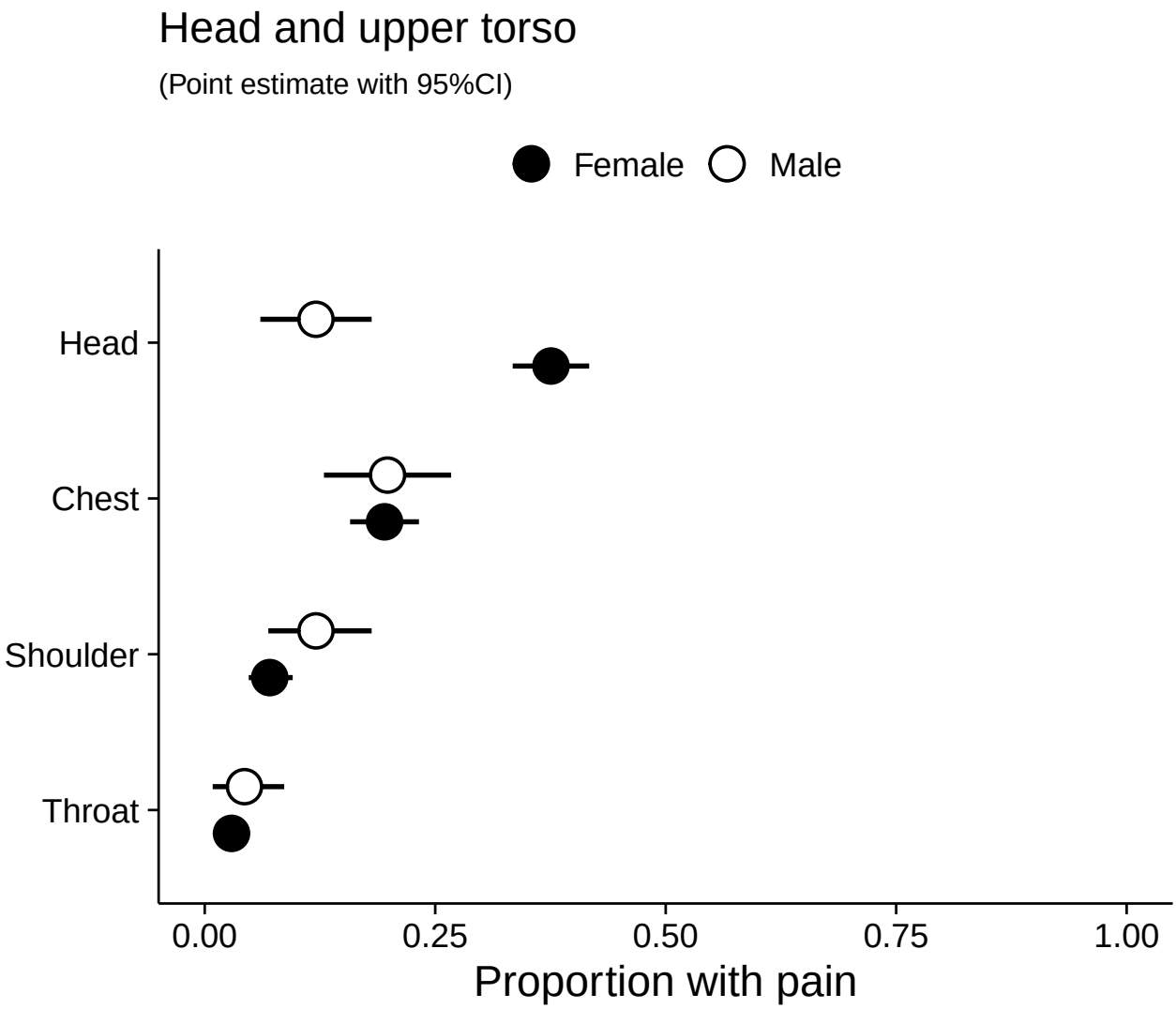
Sex	site	point_est	lower_ci	upper_ci
Female	Thoracic spine	0.14	0.11	0.17
Female	Lumbosacral spine	0.16	0.13	0.19
Male	Cervical spine	0.03	0.00	0.05
Male	Thoracic spine	0.07	0.03	0.12
Male	Lumbosacral spine	0.14	0.08	0.20

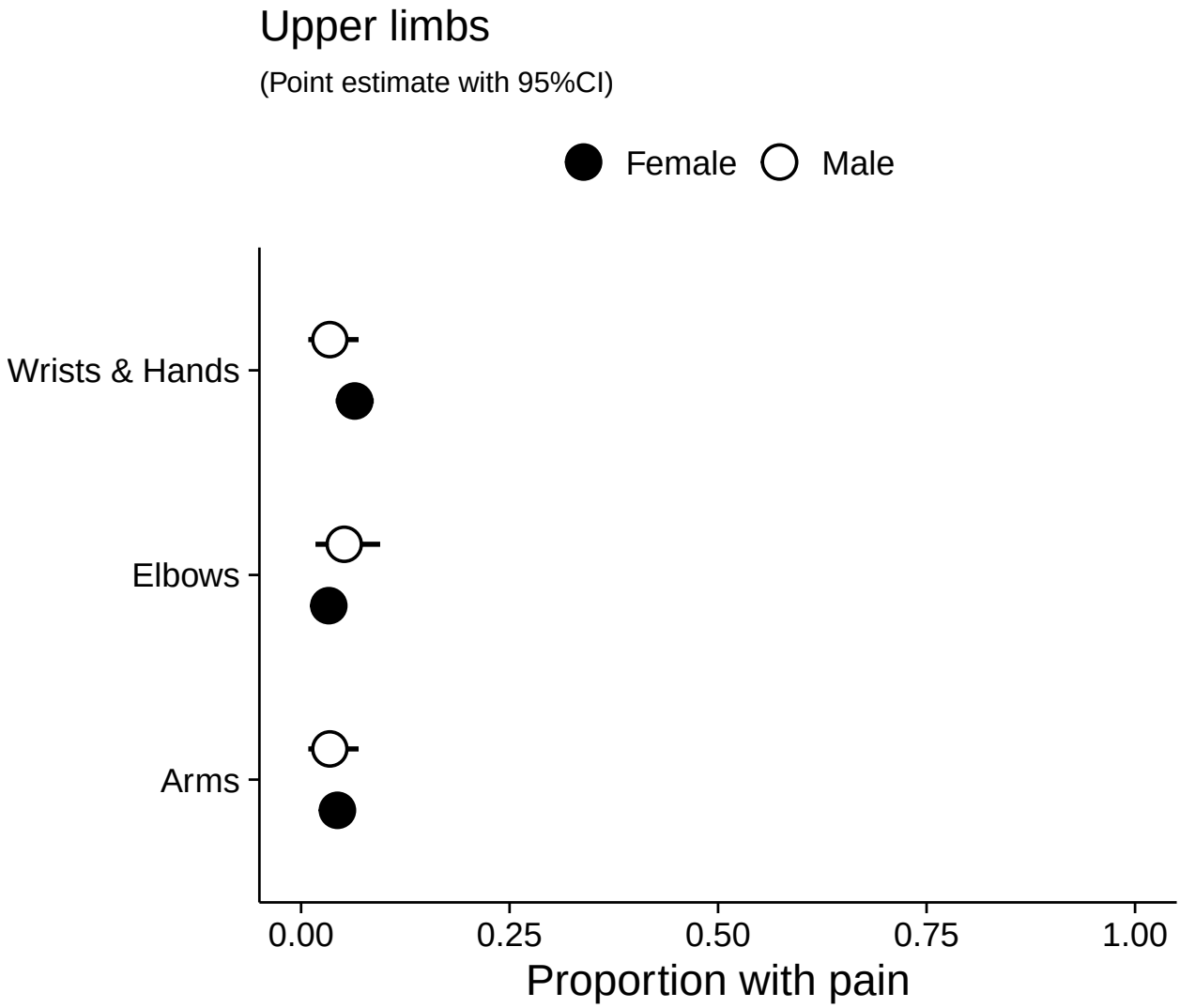
Table 15: Lower limbs

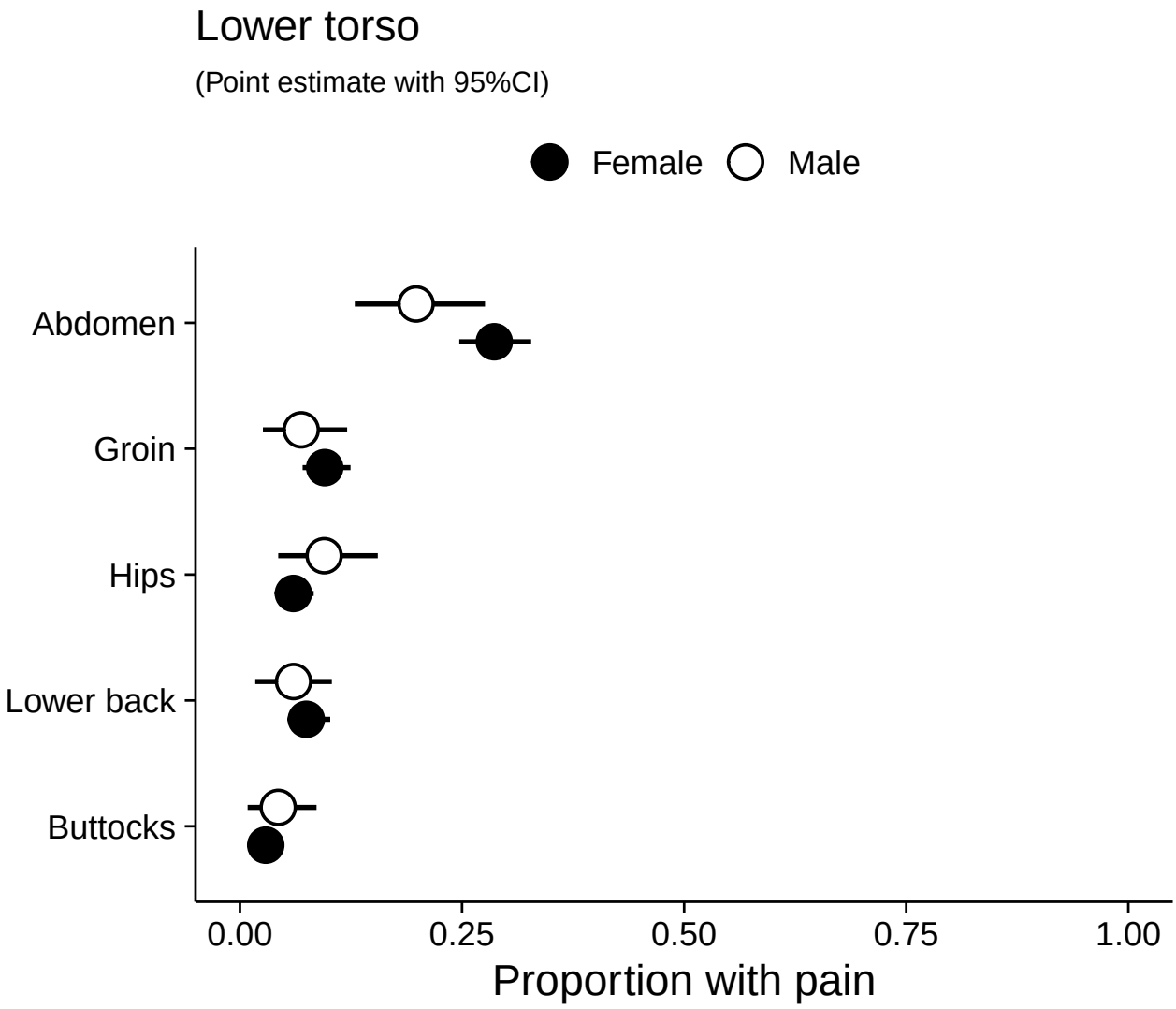
Sex	site	point_est	lower_ci	upper_ci
Female	Legs	0.15	0.12	0.18
Female	Knees	0.13	0.10	0.16
Female	Ankles & Feet	0.28	0.24	0.32
Male	Legs	0.23	0.16	0.31
Male	Knees	0.19	0.12	0.27
Male	Ankles & Feet	0.41	0.33	0.50

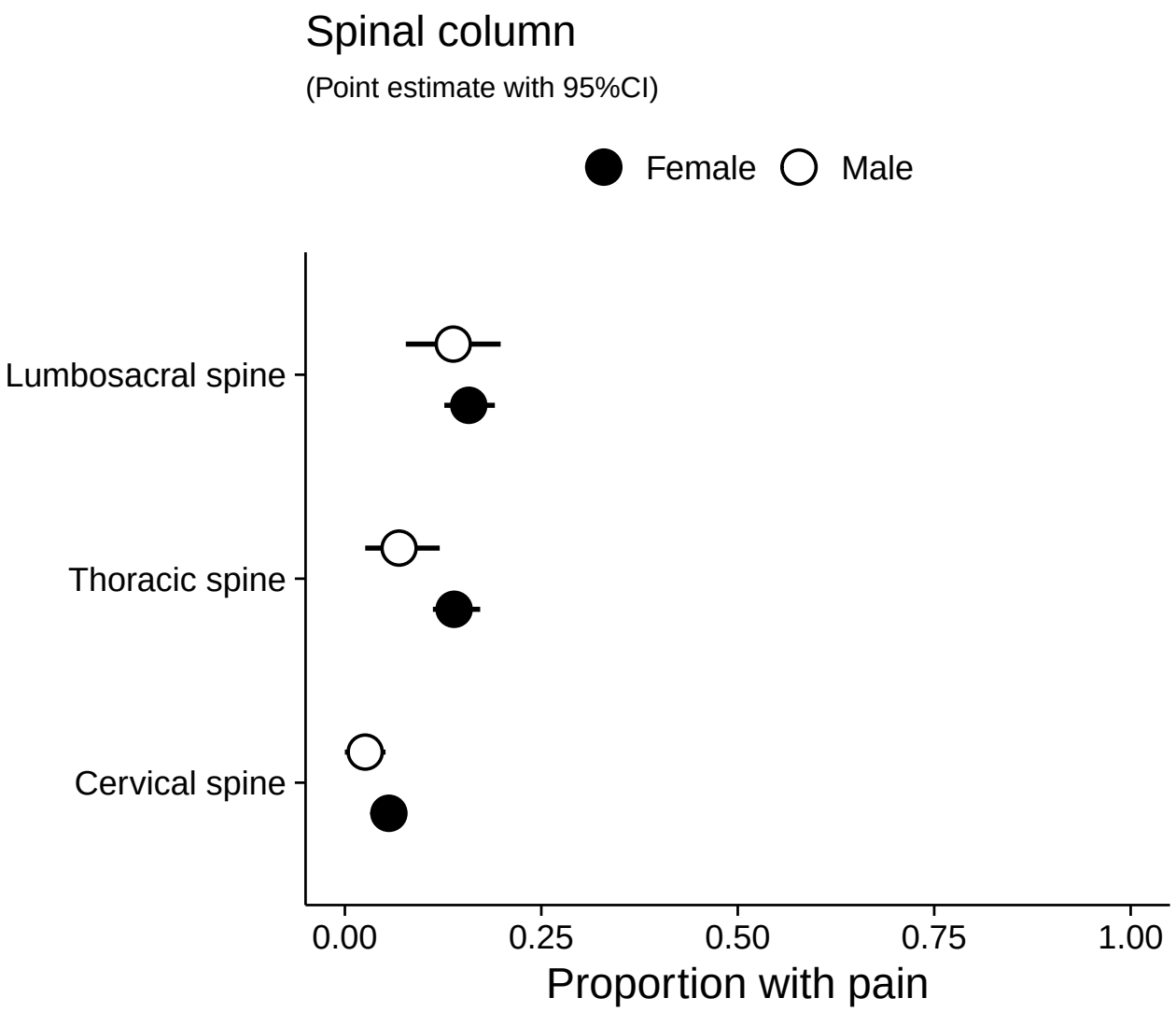
Plotted proportions (with 95% CIs), by age and body region

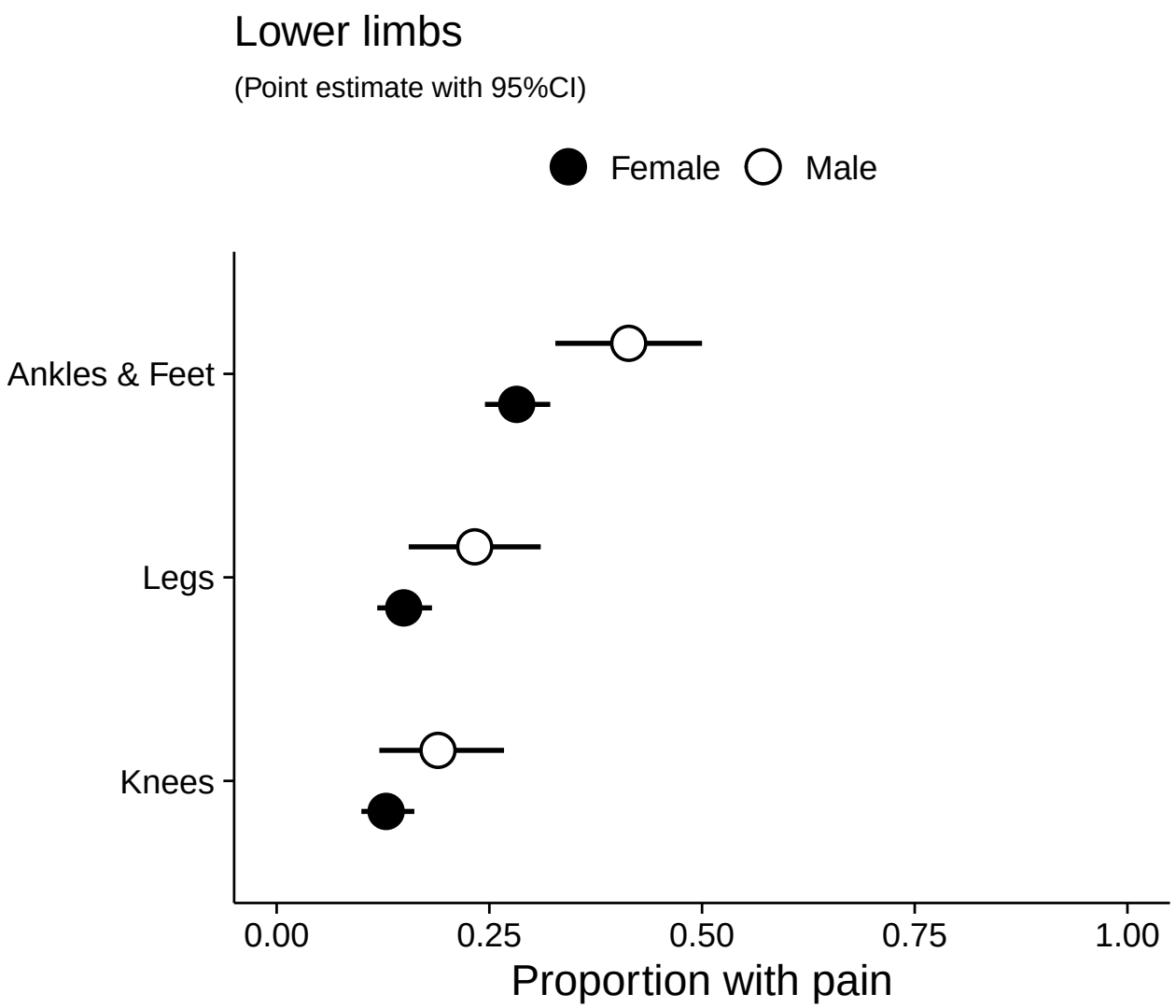
```
walk(sex_boot2$plots, ~ print(.x))
```


Head and upper torso
(Point estimate with 95%CI)
Female
Male
Head
Chest
Shoulder
Throat
0.00
0.25
0.50
0.75
1.00
Proportion with pain


Upper limbs
(Point estimate with 95%CI)
Female
Male
Wrists & Hands
Elbows
Arms
0.00
0.25
0.50
0.75
1.00
Proportion with pain


Lower torso
(Point estimate with 95%CI)
Female
Male
Abdomen
Groin
Hips
Lower back
Buttocks
0.00
0.25
0.50
0.75
1.00
Proportion with pain


Spinal column
(Point estimate with 95%CI)
Female
Male
Lumbosacral spine
Thoracic spine
Cervical spine
0.00
0.25
0.50
0.75
1.00
Proportion with pain



Hypothesis tests

Process data

```
sex_tab <- sex %>%
    # Convert to long format and nest
    pivot_longer(cols = -Sex,
                 names_to = 'site',
                 values_to = 'pain_present') %>%
    group_by(site) %>%
    nest() %>%
    # Remove site with only one outcome (based on skimr summary)
    filter(site != 'Upper_back') %>%
    # Perform chi-square test
    mutate(chi = map(.x = data,
                     ~ with(.x, chisq.test(pain_present, Sex)))) %>%
    # Perform logistic regression
```

```
    mutate(logistic = map(.x = data,
                          ~ glm(factor(pain_present) ~ factor(Sex),
                                data = .x,
                                family = binomial()))) %>%
    # Extract test statistics
    mutate(stat = map(.x = chi,
                      ~ .x$statistic[[1]]),
           p_value = map(.x = chi,
                         ~ .x$p.value),
           OR = map(.x = logistic,
                    ~ exp(coef(.x))[[2]]),
           lower_ci = map(.x = logistic,
                          ~ exp(confint(.x))[2, 1]),
           upper_ci = map(.x = logistic,
                          ~ exp(confint(.x))[2, 2]))

# Calculate adjusted p-values and then add to nested dataframe
adj_p <- p.adjust(p = sex_tab$p_value,
                  method = 'holm')
sex_tab$adj_p <- adj_p

# Generate table for each pain site
sex_tab <- sex_tab %>%
    mutate(tab = pmap(.l = list(site, stat, adj_p, OR, lower_ci, upper_ci),
                      ~ data.frame(site = ..1,
                                   statistic = ..2,
                                   df = 1,
                                   holm_pvalue = ..3,
                                   OR_Male = ..4,
                                   lower_ci = ..5,
                                   upper_ci = ..6)))
```

Tabulate hypothesis test results

```
# Bind tables and print
bind_rows(sex_tab$tab) %>%
    arrange(holm_pvalue) %>%
    kable(caption = 'Sex vs body sites: hypothesis test results',
          digits = 3)
```

Table 16: Sex vs body sites: hypothesis test results

site	statistic	df	holm_pvalue	OR_Male	lower_ci	upper_ci
Head	26.482	1	0.000	0.228	0.122	0.398
Ankles.Feet	7.000	1	0.139	1.796	1.177	2.727
Legs	4.121	1	0.678	1.728	1.037	2.818
Thoracic_spine	3.567	1	0.884	0.459	0.198	0.931
Throat	0.231	1	1.000	1.506	0.479	4.028
Shoulder	2.542	1	1.000	1.809	0.910	3.428
Arms	0.033	1	1.000	0.784	0.225	2.109
Elbows	0.458	1	1.000	1.589	0.559	3.962

site	statistic	df	holm_pvalue	OR_Male	lower_ci	upper_ci
Wrists.Hands	1.017	1	1.000	0.520	0.152	1.346
Chest	0.000	1	1.000	1.021	0.603	1.675
Lower_back	0.113	1	1.000	0.796	0.317	1.733
Abdomen	3.249	1	1.000	0.616	0.368	0.998
Cervical_spine	1.207	1	1.000	0.447	0.106	1.295
Lumbosacral_spine	0.149	1	1.000	0.855	0.463	1.494
Groin	0.508	1	1.000	0.702	0.300	1.454
Hips	1.287	1	1.000	1.636	0.761	3.294
Knees	2.401	1	1.000	1.585	0.913	2.674
Buttocks	0.231	1	1.000	1.506	0.479	4.028

By age

Process data

```
# Select age data
age <- demo[, c('ID', 'Age')]

# Join to boot_data & remove ID, Whole_body, Upper_back
age <- left_join(data, age) %>%
    select(-ID, -Whole_body, -Upper_back)

# Get complete cases
age <- age[complete.cases(age), ]

# Pivot and add age group categories (10 year periods)
age_boot <- age %>%
    # Pivot to long format
    pivot_longer(cols = -Age,
                 names_to = 'site',
                 values_to = 'pain_present') %>%
    # Add age categories
    mutate(age_group = case_when(
        Age < 28 ~ '18-27',
        Age >= 28 & Age < 38 ~ '28-37',
        Age >= 38 & Age < 48 ~ '38-47',
        Age >= 48 & Age < 58 ~ '48-57',
        Age >= 58 & Age < 68 ~ '58-67',
        Age >= 68 & Age < 78 ~ '68-77',
        Age >= 78 & Age < 88 ~ '78-87'
    ))

# Print count per age group
age_boot %>%
    group_by(site, age_group) %>%
    summarise(count = n()) %>%
    filter(site == 'Abdomen') %>%
```

```
    ungroup() %>%
    select(-site) %>%
    kable(caption = 'Participant count per age group')
```

Table 17: Participant count per age group

age_group	count
18-27	65
28-37	284
38-47	160
48-57	59
58-67	20
68-77	2

```
# Generate CIs
age_boot2 <- age_boot %>%
    # Remove age
    select(-Age) %>%
    # Remove categories with less than 20 counts
    filter(age_group != '68-77') %>%
    # Nest by age group and body site
    group_by(age_group, site) %>%
    nest() %>%
    # Boostrap data
    mutate(boot = map(.x = data,
                      ~ boot(data = .x,
                             statistic = prop_func,
                             R = 999,
                             stype = 'i'))) %>%
    # Get CI
    mutate(ci = map(.x = boot,
                    ~ boot.ci(.x, type = 'perc'))) %>%
    # Extract ci data
    mutate(point_est = map(.x = ci,
                           ~ .x$t0),
           lower_ci = map(.x = ci,
                          ~ .x$percent[[4]]),
           upper_ci = map(.x = ci,
                          ~ .x$percent[[5]])) %>%
    # Remove columns
    select(-data, -boot, -ci) %>%
    # Unnest
    unnest(cols = c(point_est, lower_ci, upper_ci)) %>%
    ungroup()

# Re-nest by body region and generate figures and tables
age_boot2 <- age_boot2 %>%
    # Fix site labels
    mutate(site = str_replace_all(site,
                                  pattern = '_',
                                  replacement = ' '),
           site = str_replace_all(site,
```

```
                                pattern = '\\.',
                                replacement = ' & ')) %>%
    # Group and nest
    group_by(site) %>%
    nest() %>%
    # Plot data
    mutate(plots = map2(.x = data,
                        .y = site,
                        ~ .x %>%
                            ggplot(data = .) +
                            aes(x = age_group,
                                y = point_est,
                                ymin = lower_ci,
                                ymax = upper_ci) +
                            geom_linerange(size = 1,
                                           colour = '#000000') +
                            geom_point(colour = '#000000',
                                       size = 6) +
                            labs(title = .y,
                                 subtitle = '(Point estimate with 95%CI)',
                                 x = 'Age group (Years)',
                                 y = 'Proportion with pain') +
                            scale_y_continuous(limits = c(0, 1)) +
                            theme_minimal(base_size = 18) +
                            theme(plot.title = element_text(size = 18),
                                  plot.subtitle = element_text(size = 12),
                                  panel.grid = element_blank(),
                                  axis.text = element_text(colour = '#000000'),
                                  axis.line = element_line(size = 0.5),
                                  axis.ticks = element_line(size = 0.5)))) %>%
    # Tabulate data
    mutate(tables = map2(.x = data,
                         .y = site,
                         ~ .x %>%
                             kable(caption = .y,
                                   digits = 2)))
```

Tabulated proportions (with 95% CIs), by age group and body site

```
walk(age_boot2$tables, ~ print(.x))
```

Table 18: Head

age_group	point_est	lower_ci	upper_ci
28-37	0.33	0.28	0.39
18-27	0.45	0.32	0.55
38-47	0.31	0.24	0.39
48-57	0.17	0.08	0.27
58-67	0.35	0.15	0.55

Table 19: Throat

age_group	point_est	lower_ci	upper_ci
28-37	0.03	0.01	0.05
18-27	0.05	0.00	0.09
38-47	0.03	0.01	0.06
48-57	0.05	0.00	0.12
58-67	0.00	0.00	0.00

Table 20: Shoulder

age_group	point_est	lower_ci	upper_ci
28-37	0.07	0.04	0.10
18-27	0.12	0.05	0.22
38-47	0.09	0.05	0.14
48-57	0.07	0.02	0.14
58-67	0.05	0.00	0.15

Table 21: Arms

age_group	point_est	lower_ci	upper_ci
28-37	0.04	0.02	0.07
18-27	0.02	0.00	0.05
38-47	0.06	0.02	0.09
48-57	0.05	0.00	0.12
58-67	0.00	0.00	0.00

Table 22: Elbows

age_group	point_est	lower_ci	upper_ci
28-37	0.03	0.01	0.05
18-27	0.00	0.00	0.00
38-47	0.04	0.01	0.07
48-57	0.05	0.00	0.10
58-67	0.15	0.00	0.35

Table 23: Wrists & Hands

age_group	point_est	lower_ci	upper_ci
28-37	0.07	0.04	0.10
18-27	0.02	0.00	0.05
38-47	0.04	0.01	0.07
48-57	0.07	0.02	0.14
58-67	0.15	0.00	0.30

Table 24: Chest

age_group	point_est	lower_ci	upper_ci
28-37	0.20	0.16	0.25
18-27	0.17	0.09	0.26
38-47	0.20	0.14	0.26
48-57	0.19	0.08	0.29
58-67	0.20	0.05	0.40

Table 25: Lower back

age_group	point_est	lower_ci	upper_ci
28-37	0.07	0.04	0.10
18-27	0.09	0.03	0.17
38-47	0.05	0.02	0.09
48-57	0.10	0.03	0.19
58-67	0.10	0.00	0.25

Table 26: Abdomen

age_group	point_est	lower_ci	upper_ci
28-37	0.32	0.26	0.38
18-27	0.23	0.14	0.34
38-47	0.29	0.22	0.36
48-57	0.12	0.03	0.20
58-67	0.05	0.00	0.15

Table 27: Cervical spine

age_group	point_est	lower_ci	upper_ci
28-37	0.05	0.02	0.08
18-27	0.12	0.05	0.22
38-47	0.04	0.01	0.08
48-57	0.00	0.00	0.00
58-67	0.00	0.00	0.00

Table 28: Thoracic spine

age_group	point_est	lower_ci	upper_ci
28-37	0.14	0.10	0.19
18-27	0.18	0.09	0.28
38-47	0.07	0.03	0.11
48-57	0.10	0.03	0.19
58-67	0.25	0.10	0.45

Table 29: Lumbosacral spine

age_group	point_est	lower_ci	upper_ci
28-37	0.15	0.11	0.20
18-27	0.18	0.09	0.28
38-47	0.12	0.07	0.17
48-57	0.15	0.07	0.25
58-67	0.40	0.20	0.65

Table 30: Groin

age_group	point_est	lower_ci	upper_ci
28-37	0.10	0.07	0.14
18-27	0.09	0.03	0.17
38-47	0.09	0.04	0.13
48-57	0.05	0.00	0.12
58-67	0.05	0.00	0.15

Table 31: Hips

age_group	point_est	lower_ci	upper_ci
28-37	0.05	0.02	0.07
18-27	0.03	0.00	0.08
38-47	0.09	0.05	0.14
48-57	0.14	0.05	0.24
58-67	0.10	0.00	0.25

Table 32: Legs

age_group	point_est	lower_ci	upper_ci
28-37	0.13	0.09	0.17
18-27	0.12	0.05	0.22
38-47	0.21	0.15	0.28
48-57	0.29	0.19	0.41
58-67	0.20	0.05	0.40

Table 33: Knees

age_group	point_est	lower_ci	upper_ci
28-37	0.10	0.07	0.14
18-27	0.11	0.05	0.18
38-47	0.17	0.11	0.22
48-57	0.22	0.12	0.32
58-67	0.30	0.10	0.50

Table 34: Ankles & Feet

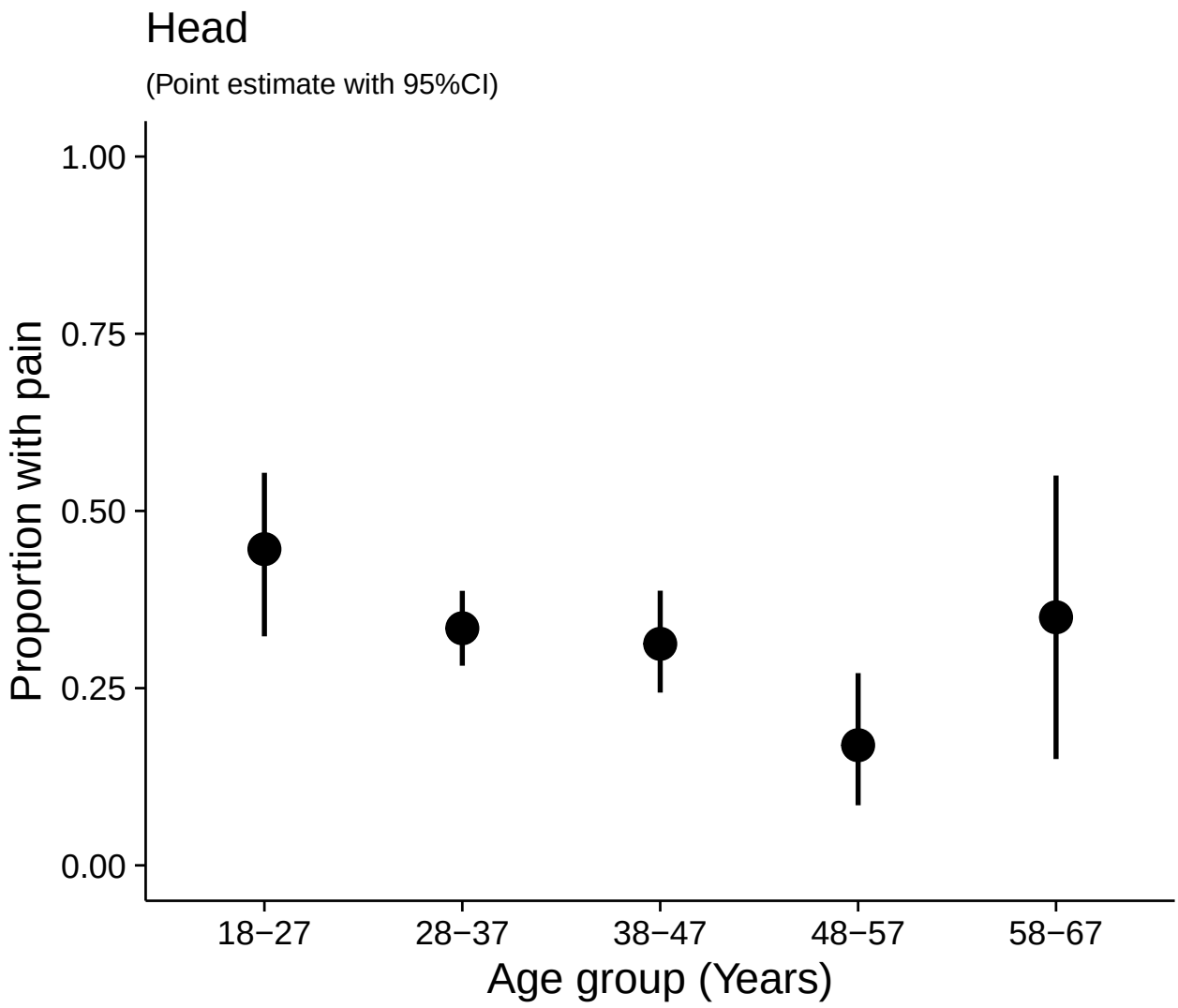
age_group	point_est	lower_ci	upper_ci
28-37	0.24	0.19	0.29
18-27	0.22	0.12	0.32
38-47	0.37	0.29	0.44
48-57	0.51	0.39	0.64
58-67	0.55	0.35	0.75

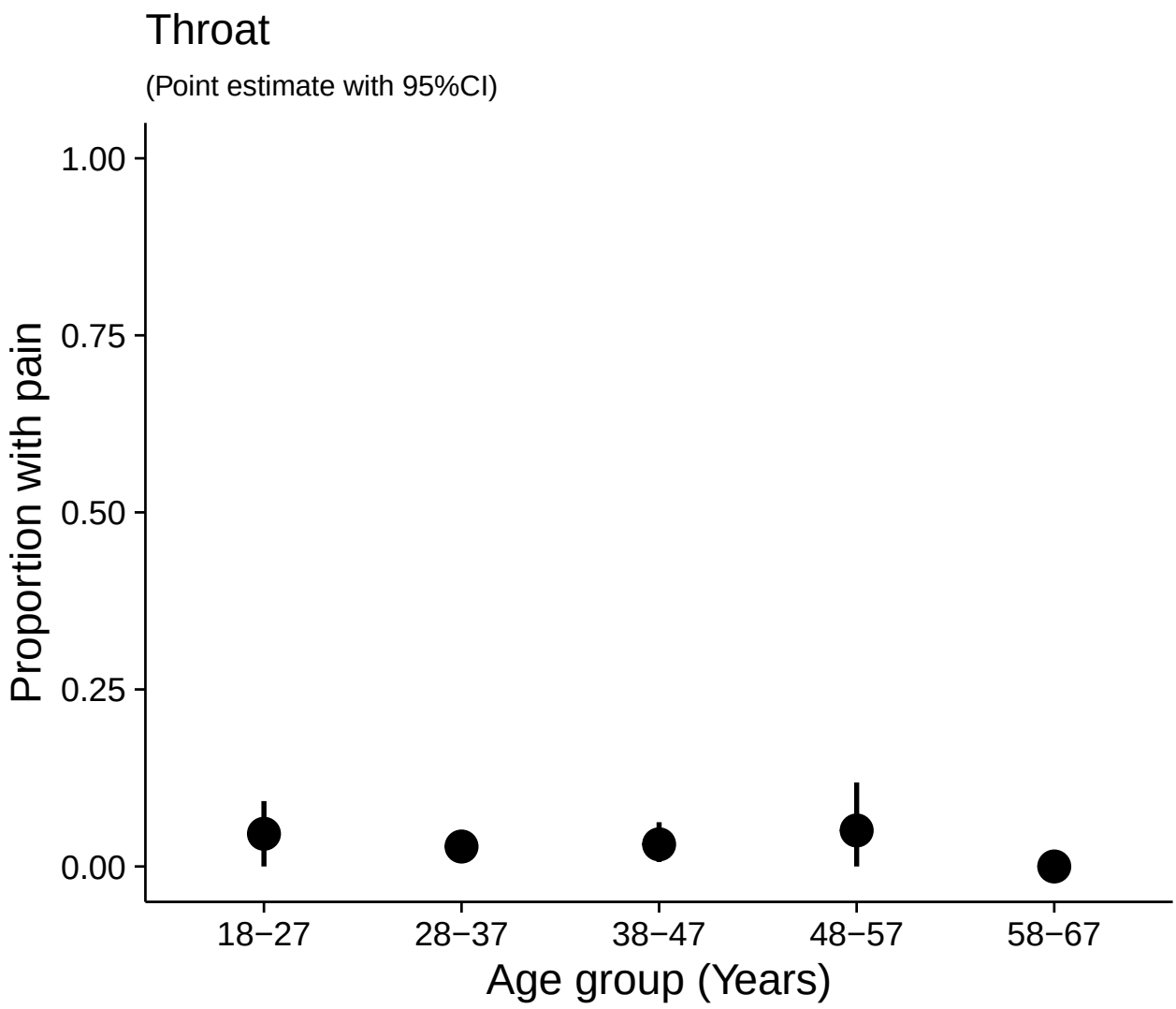
Table 35: Buttocks

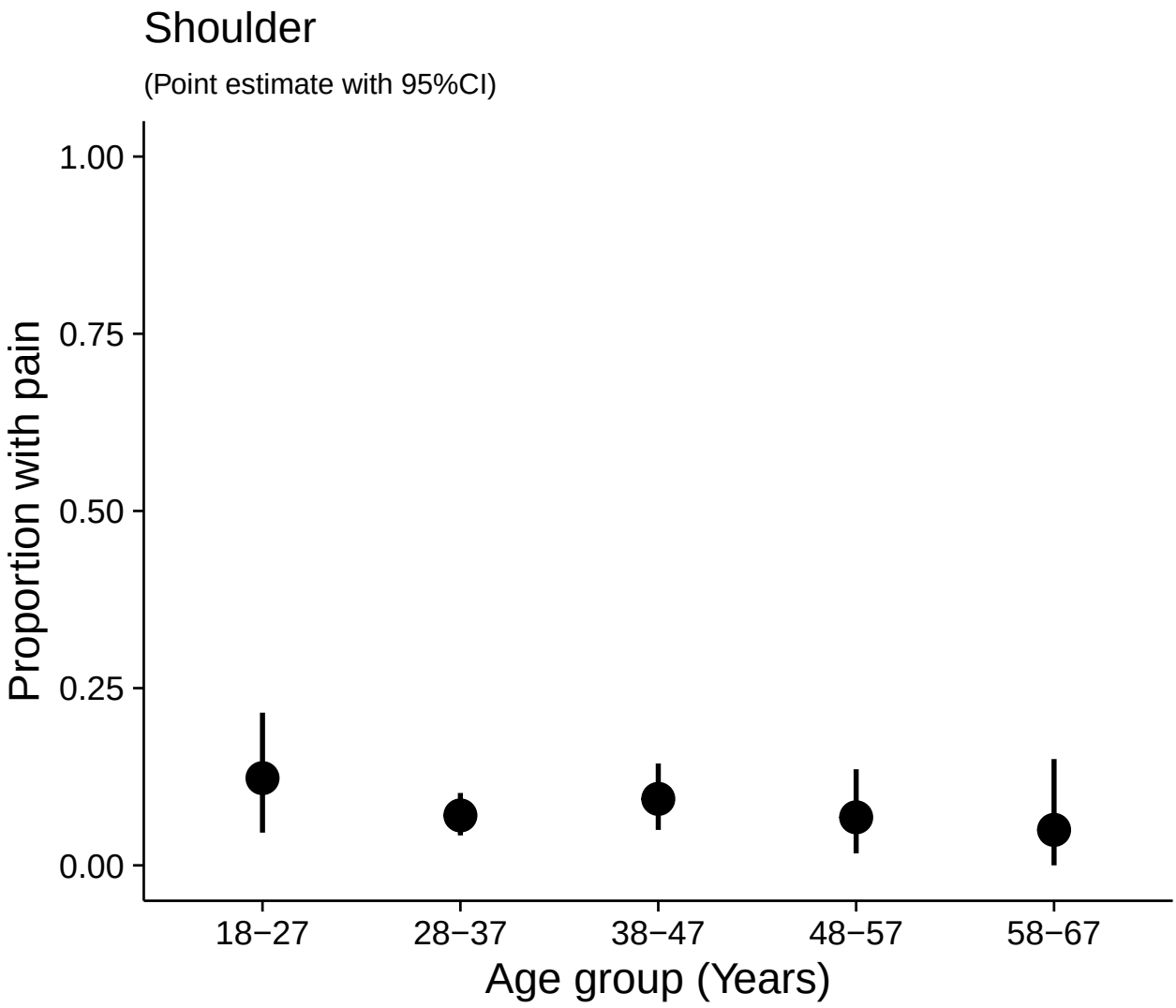
age_group	point_est	lower_ci	upper_ci
28-37	0.04	0.02	0.06
18-27	0.03	0.00	0.08
38-47	0.02	0.01	0.05
48-57	0.02	0.00	0.05
58-67	0.05	0.00	0.15

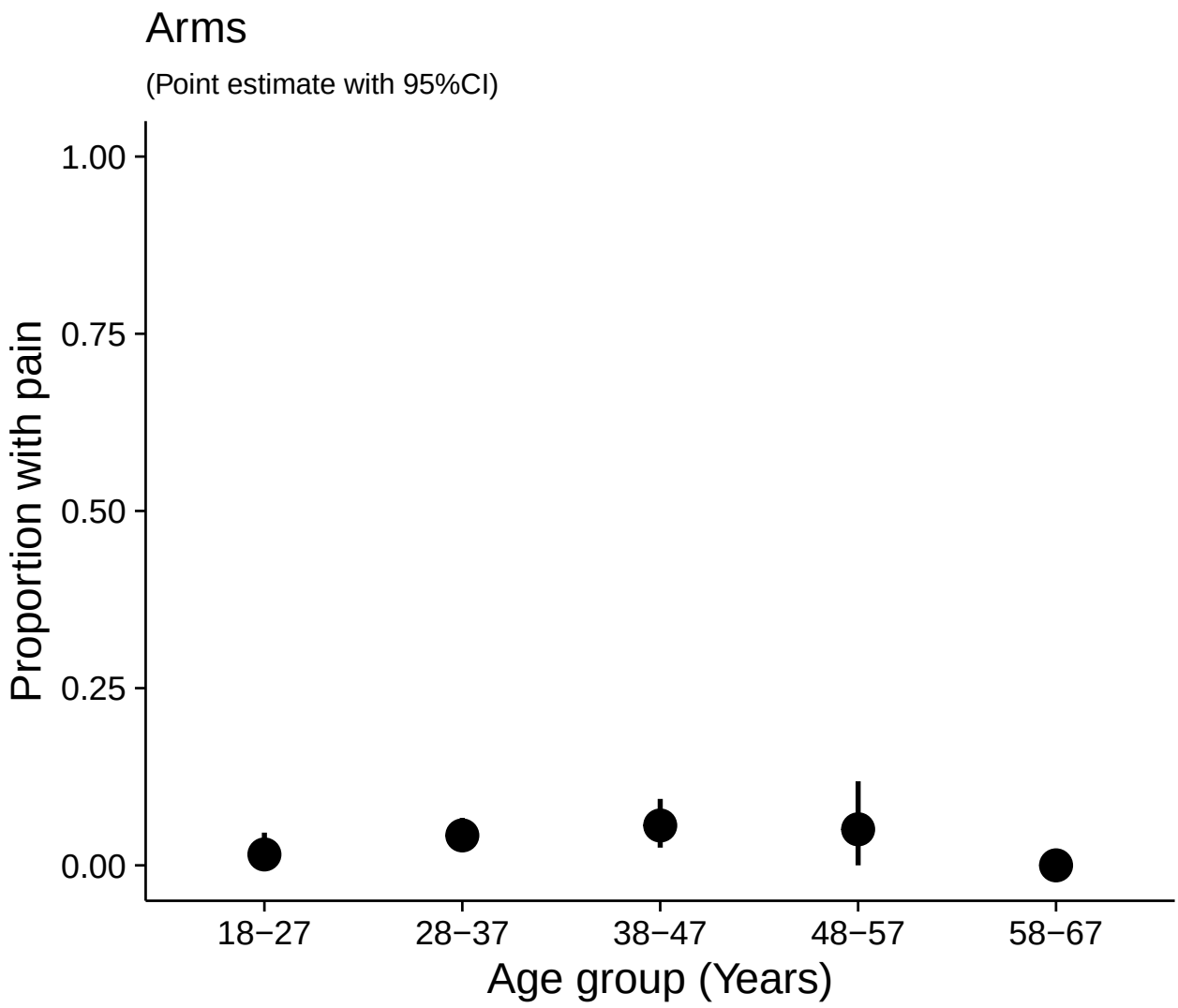
Plotted proportions (with 95% CIs), by age group and body site

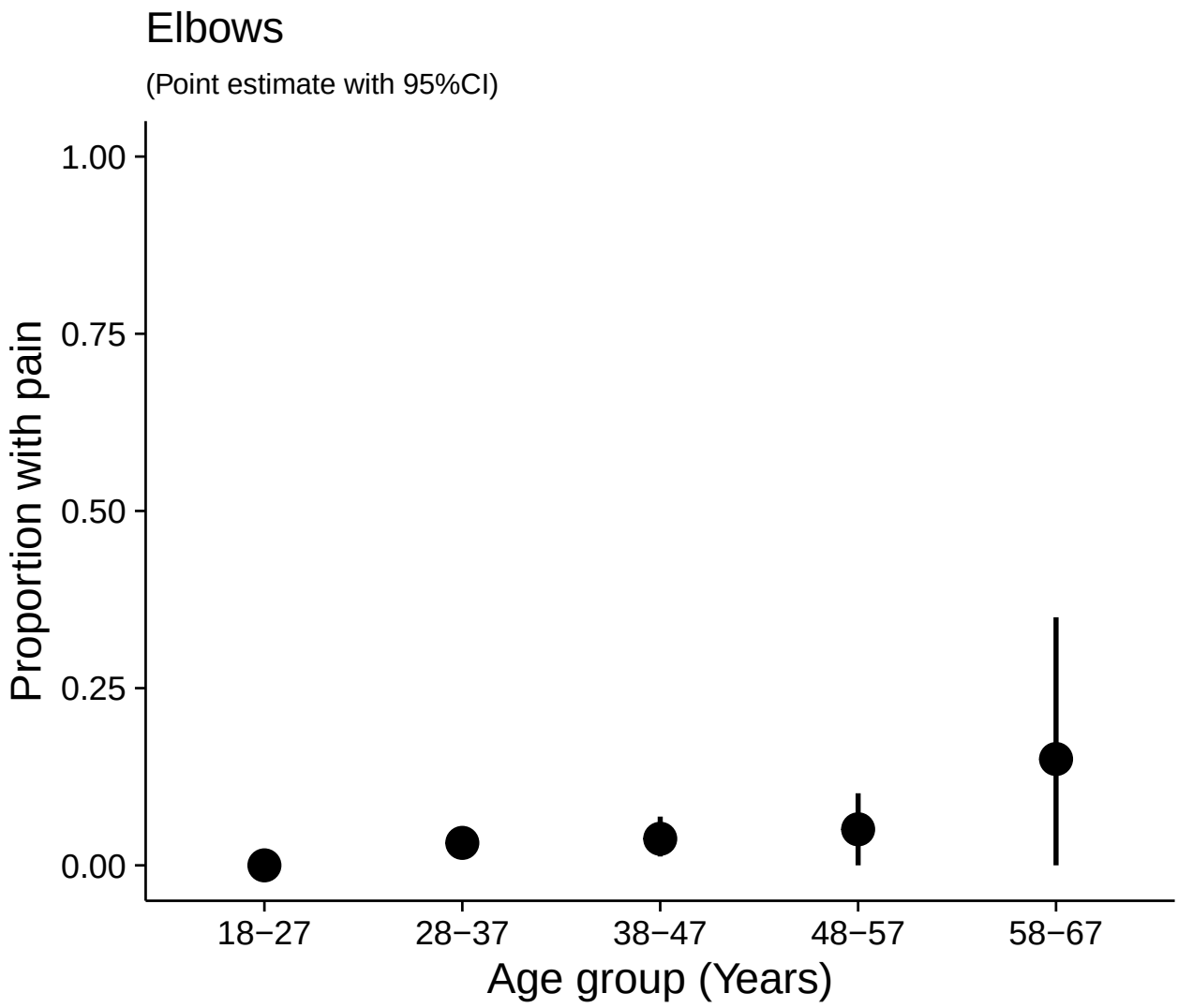
```
walk(age_boot2$plots, ~ print(.x))
```

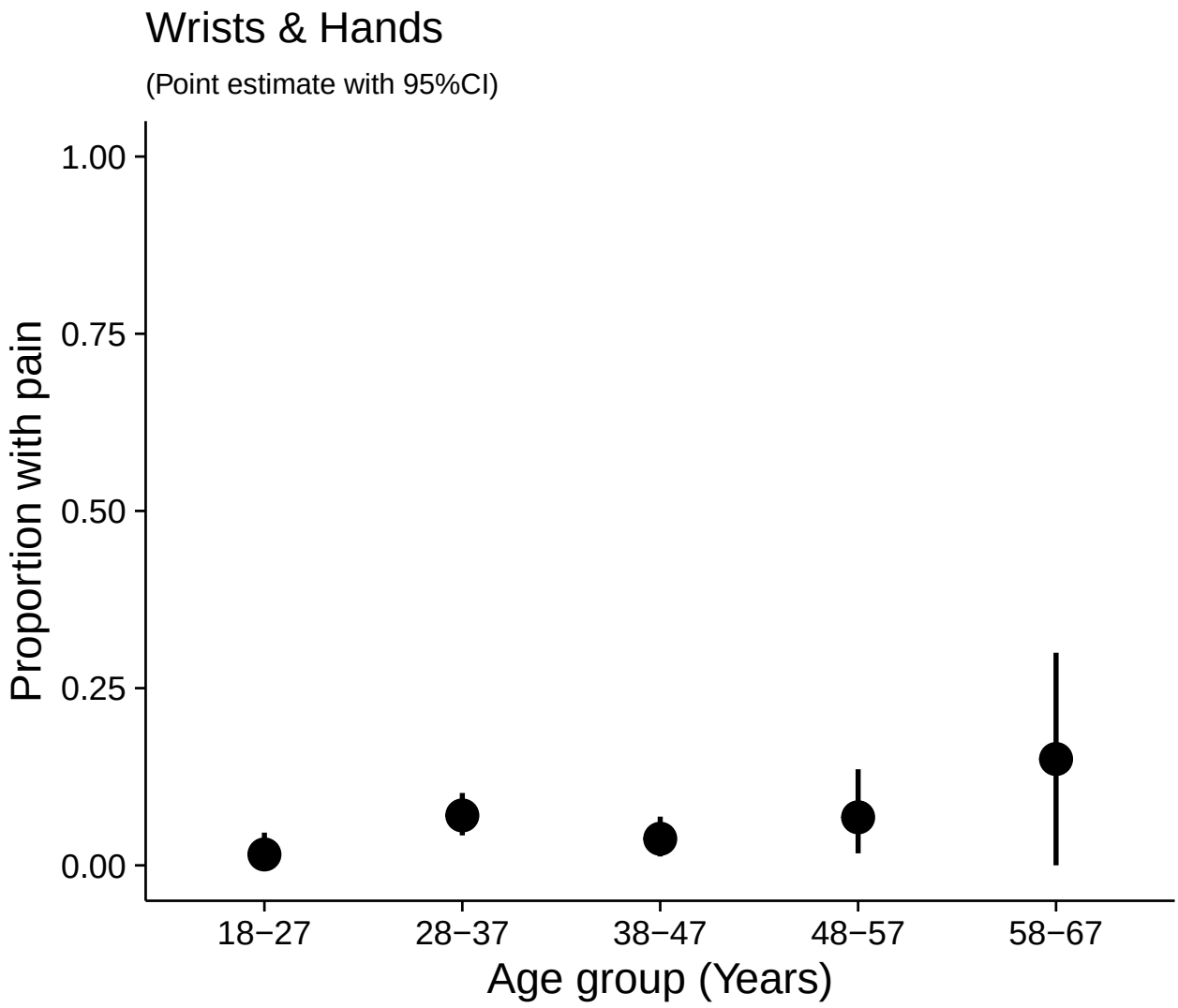

Head
(Point estimate with 95%CI)
Proportion with pain
1.00
0.75
0.50
0.25
0.00
18−27
28−37
38−47
48−57
58−67
Age group (Years)

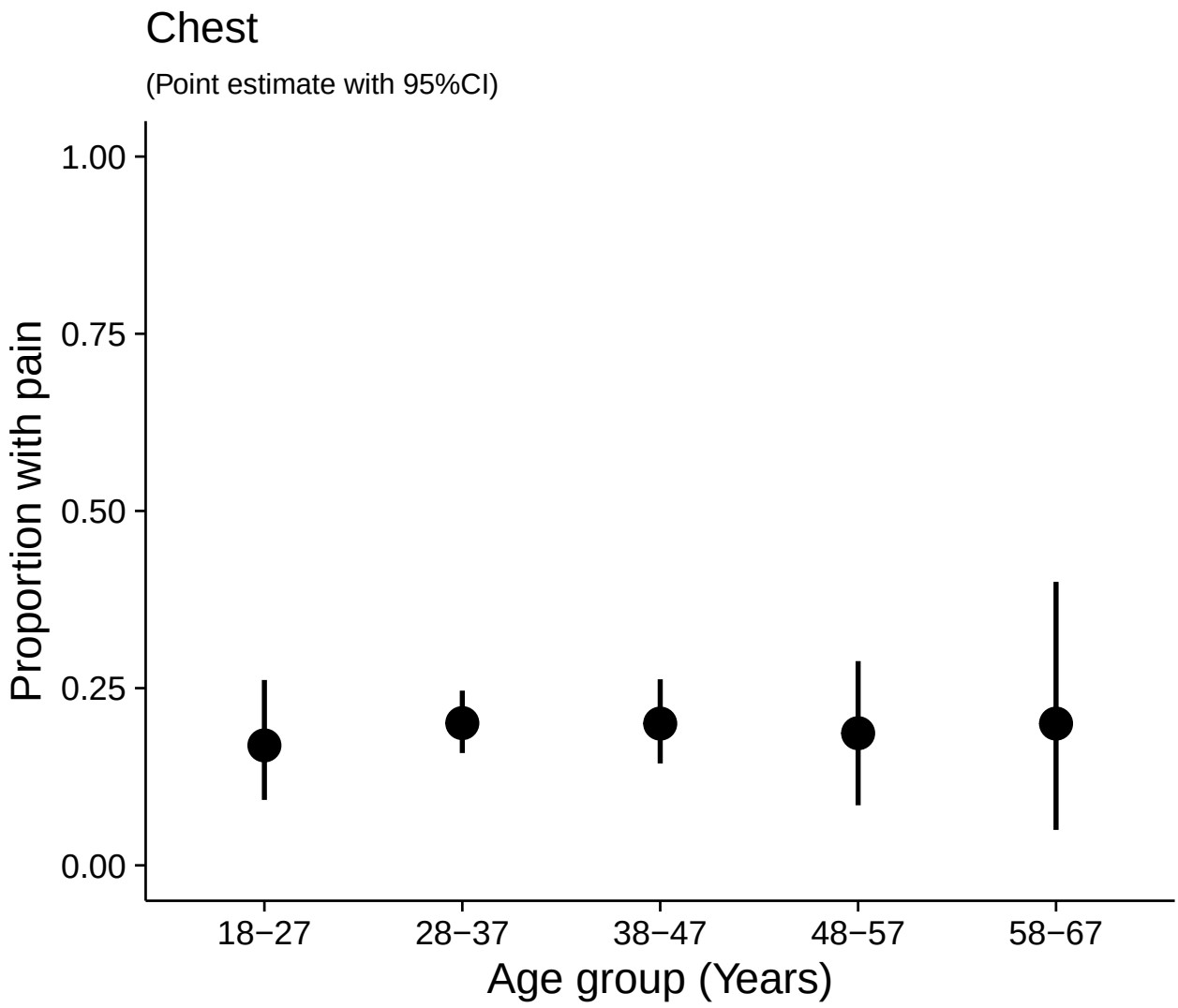

Throat
(Point estimate with 95%CI)
1.00
0.75
0.50
0.25
0.00
Proportion with pain
18−27
28−37
38−47
48−57
58−67
Age group (Years)

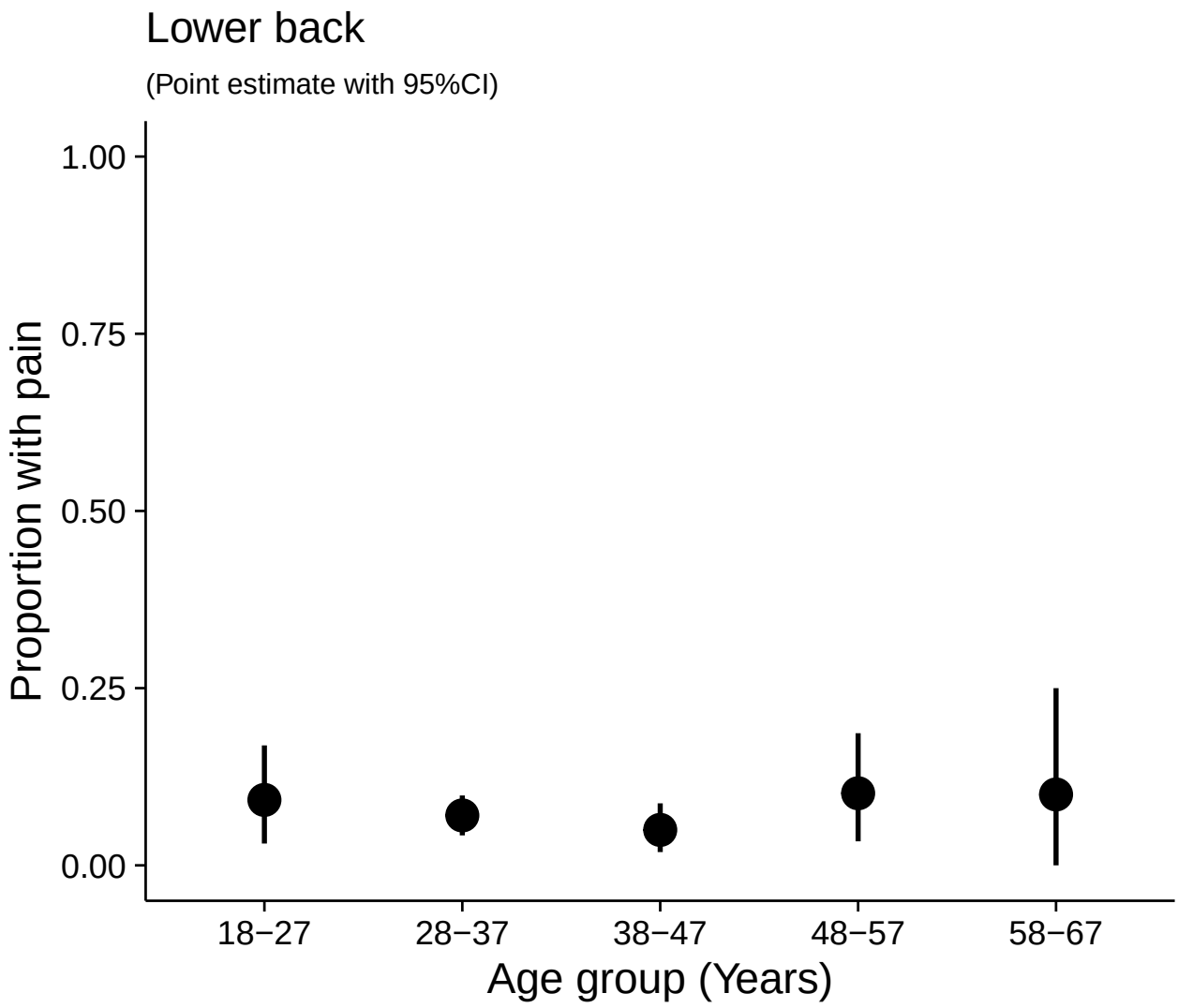

Shoulder
(Point estimate with 95%CI)
1.00
0.75
0.50
0.25
0.00
Proportion with pain
18−27
28−37
38−47
48−57
58−67
Age group (Years)

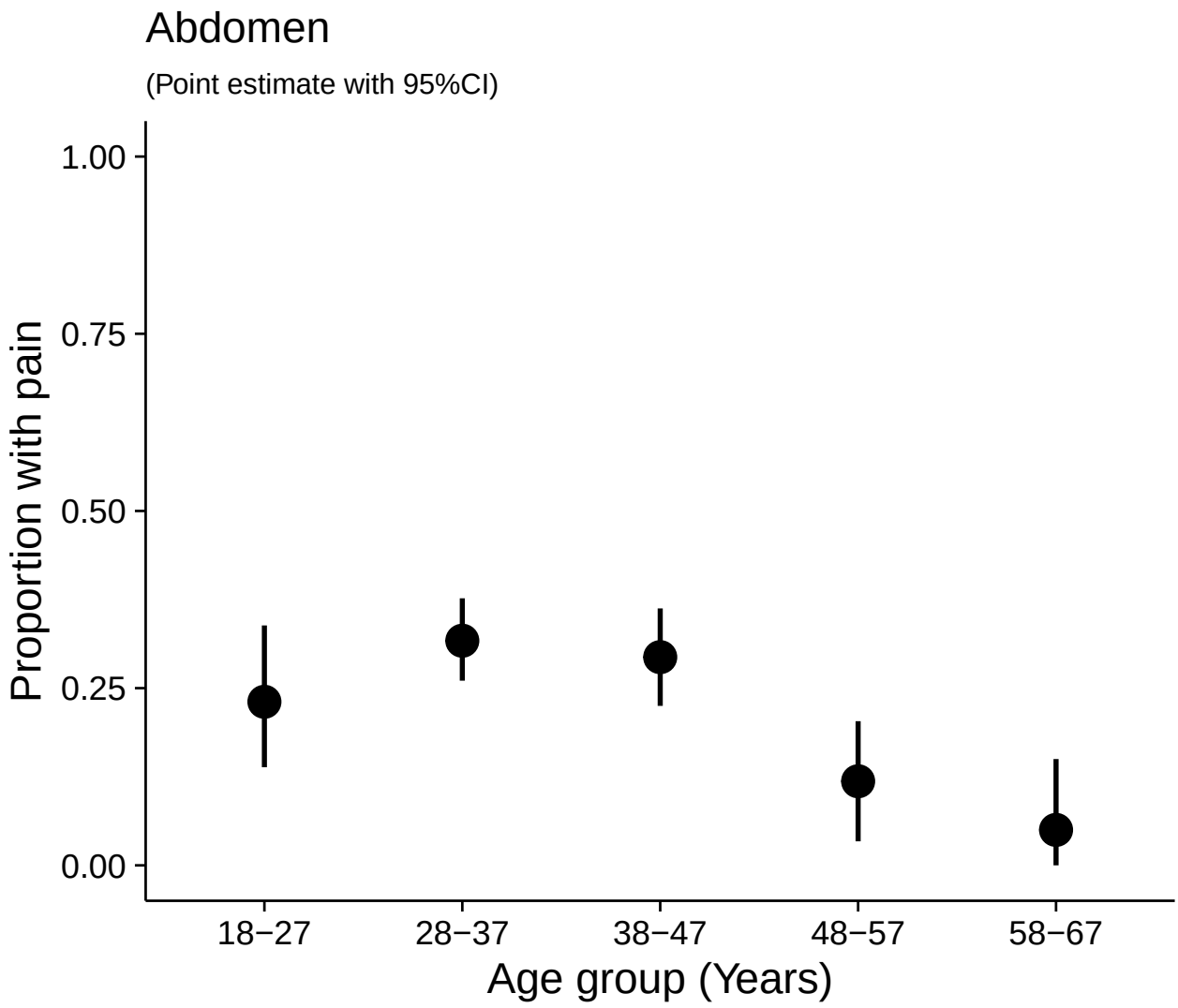

Arms
(Point estimate with 95%CI)
1.00
0.75
0.50
0.25
0.00
Proportion with pain
18−27
28−37
38−47
48−57
58−67
Age group (Years)

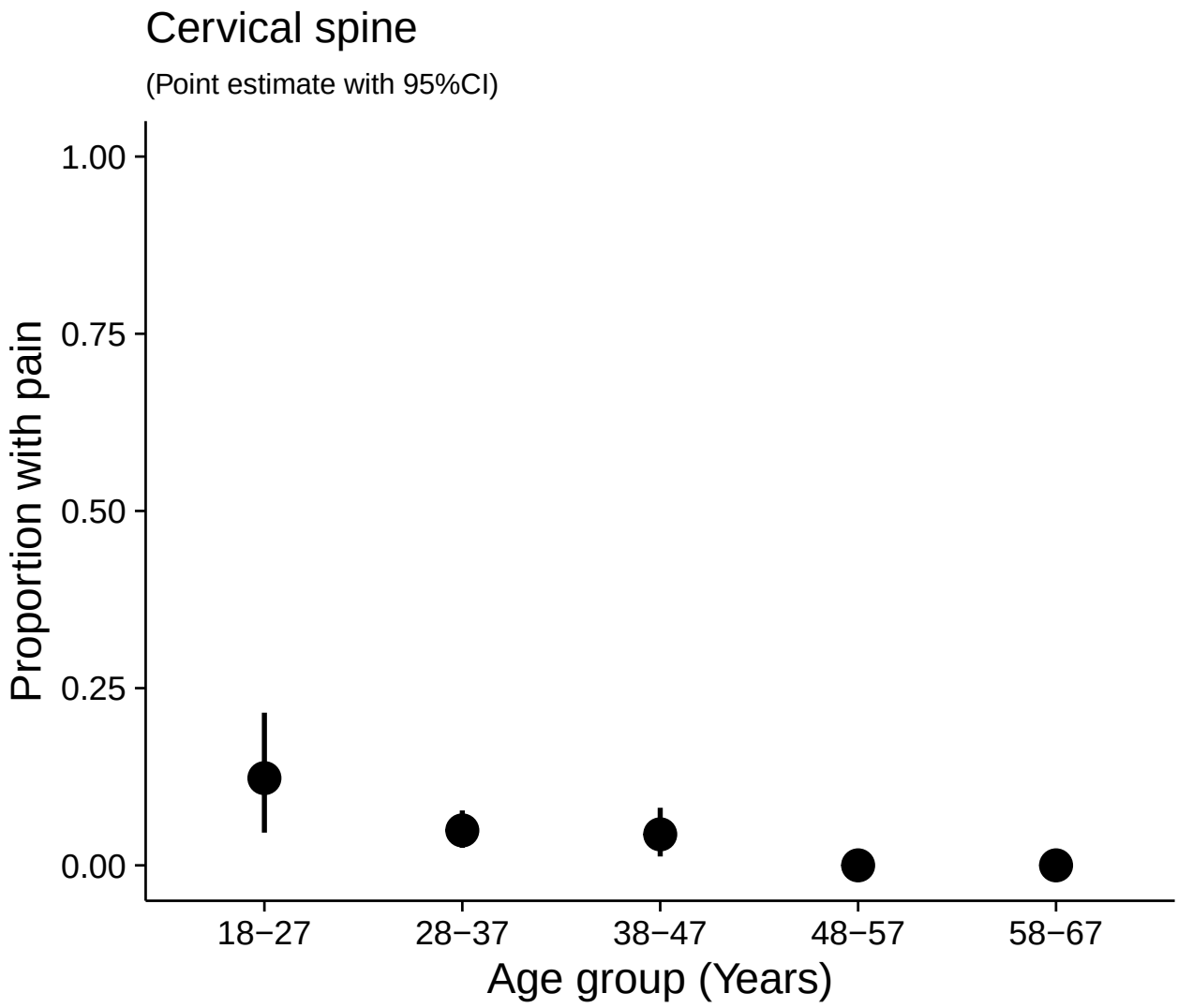

Elbows
(Point estimate with 95%CI)
1.00
0.75
0.50
0.25
0.00
Proportion with pain
18−27
28−37
38−47
48−57
58−67
Age group (Years)

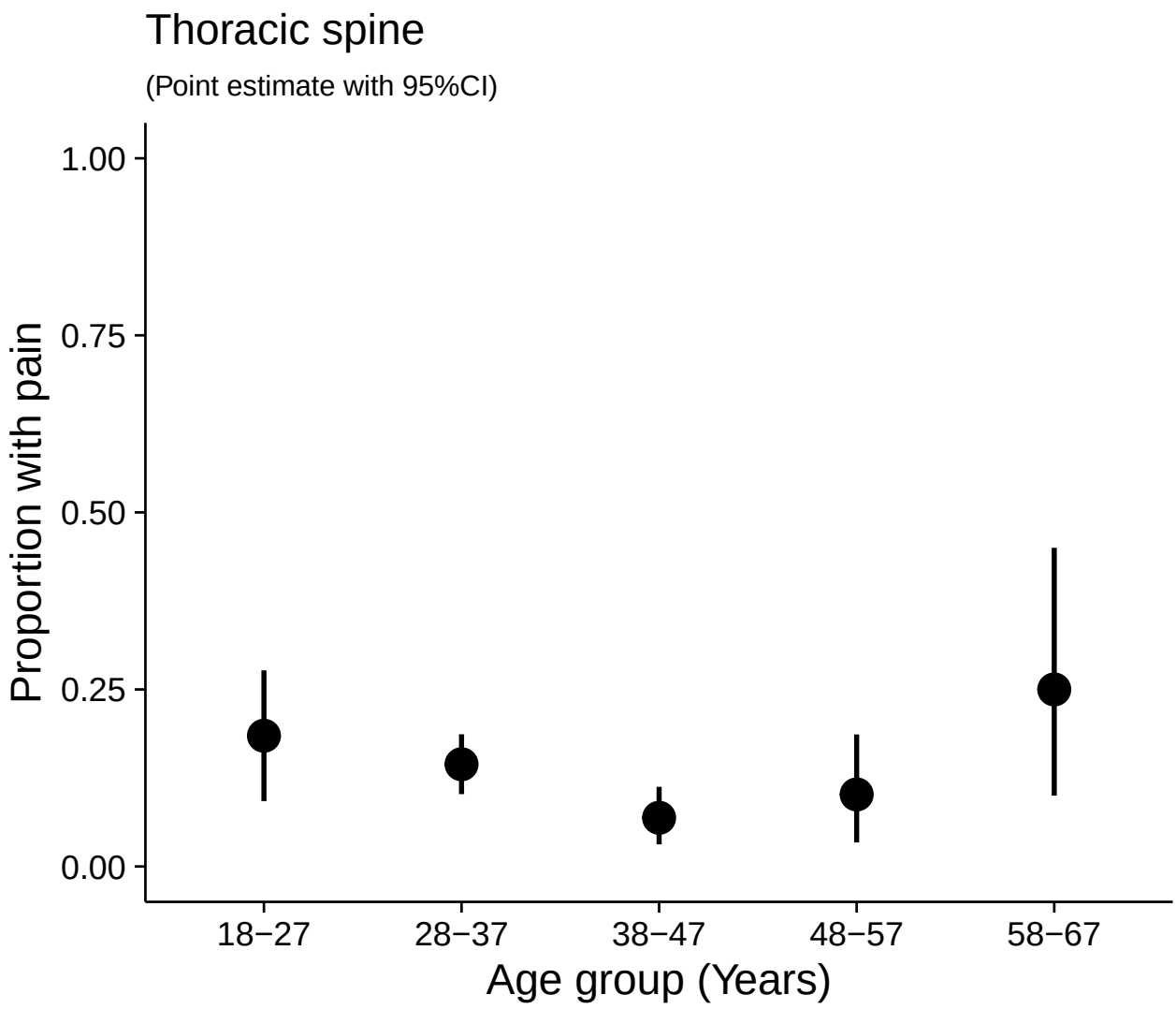

Wrists & Hands
(Point estimate with 95%CI)
Proportion with pain
1.00
0.75
0.50
0.25
0.00
18−27
28−37
38−47
48−57
58−67
Age group (Years)

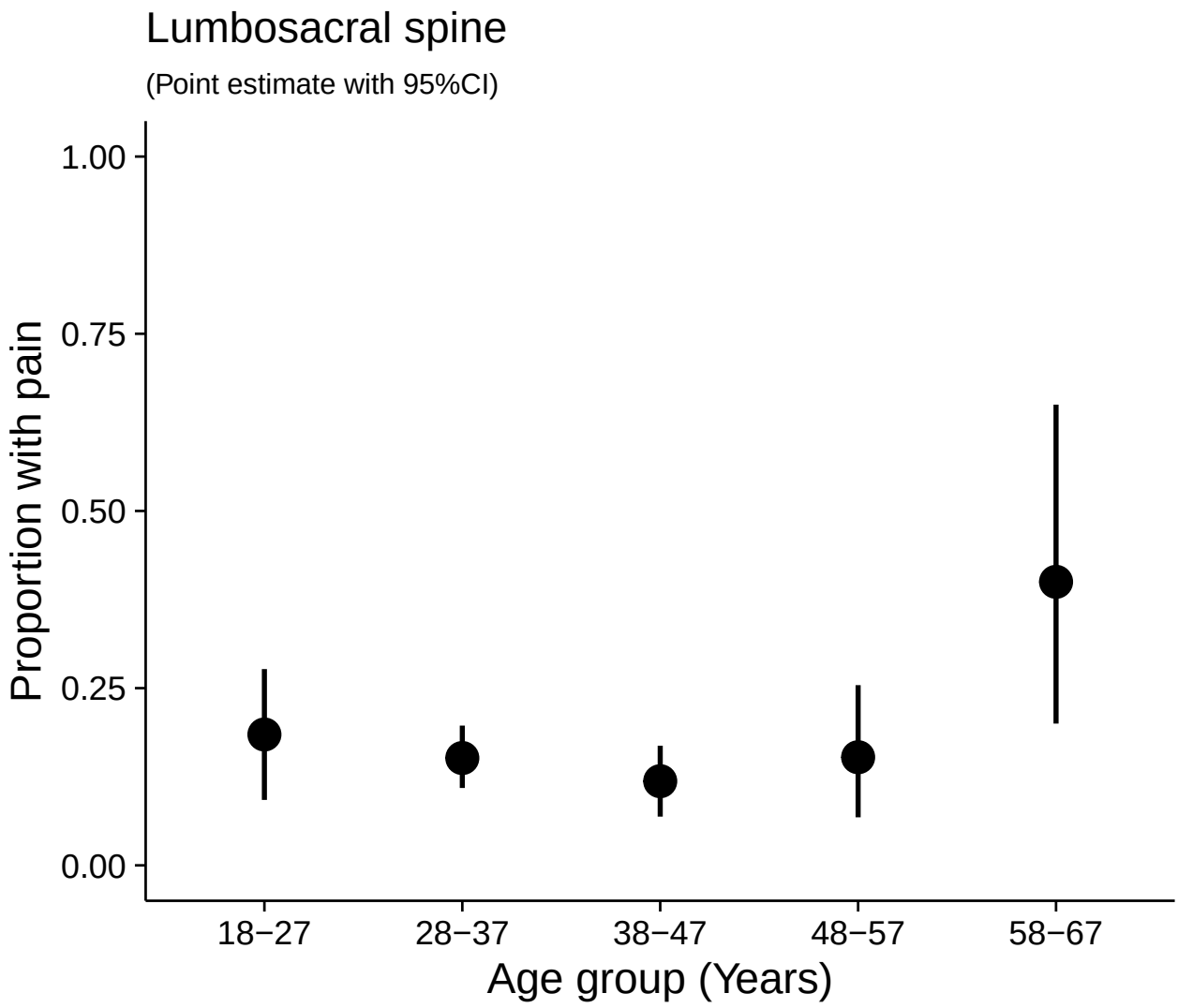

Chest
(Point estimate with 95%CI)
Proportion with pain
1.00
0.75
0.50
0.25
0.00
18−27
28−37
38−47
48−57
58−67
Age group (Years)

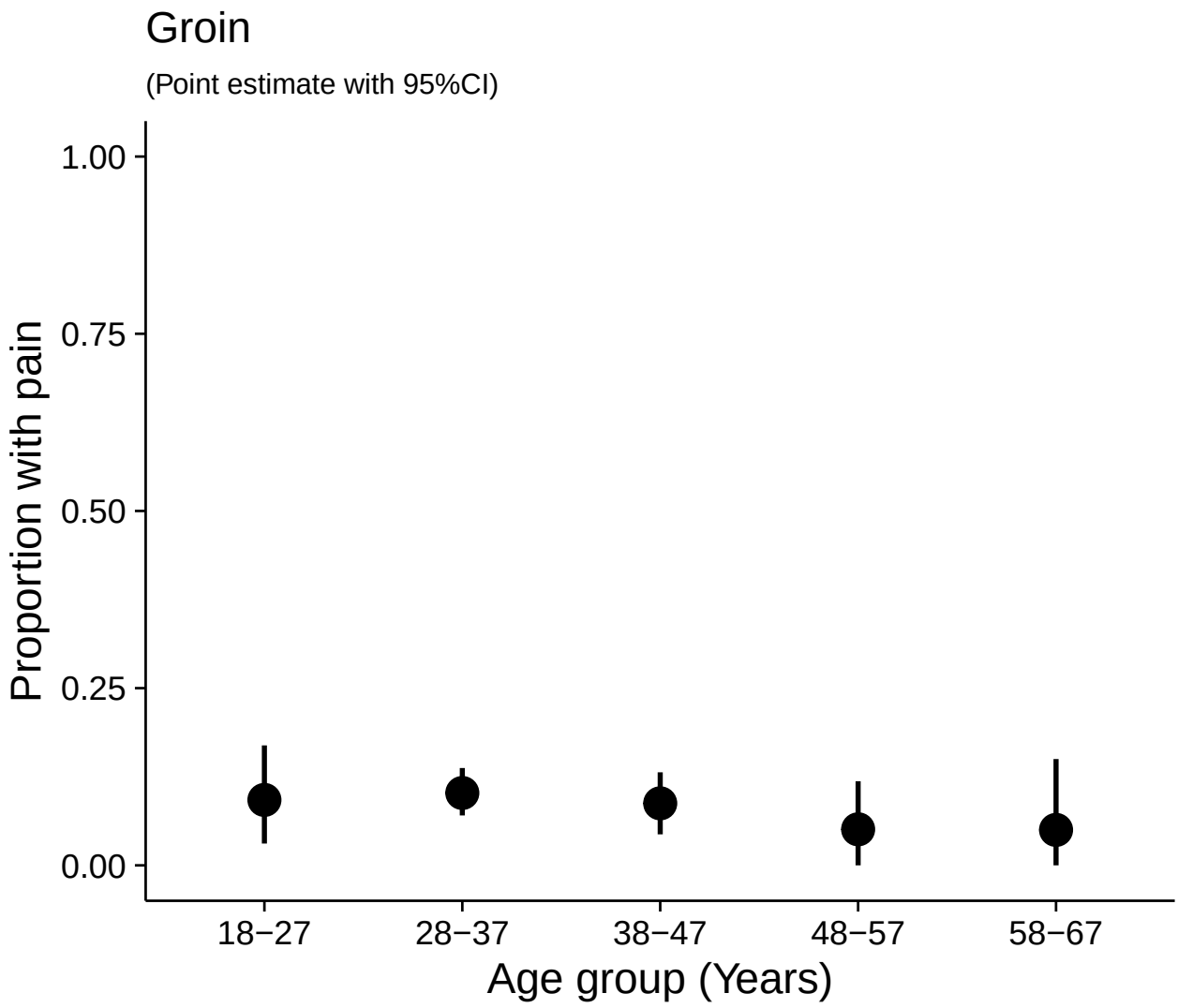

Lower back
(Point estimate with 95%CI)
Proportion with pain
1.00
0.75
0.50
0.25
0.00
18−27
28−37
38−47
48−57
58−67
Age group (Years)

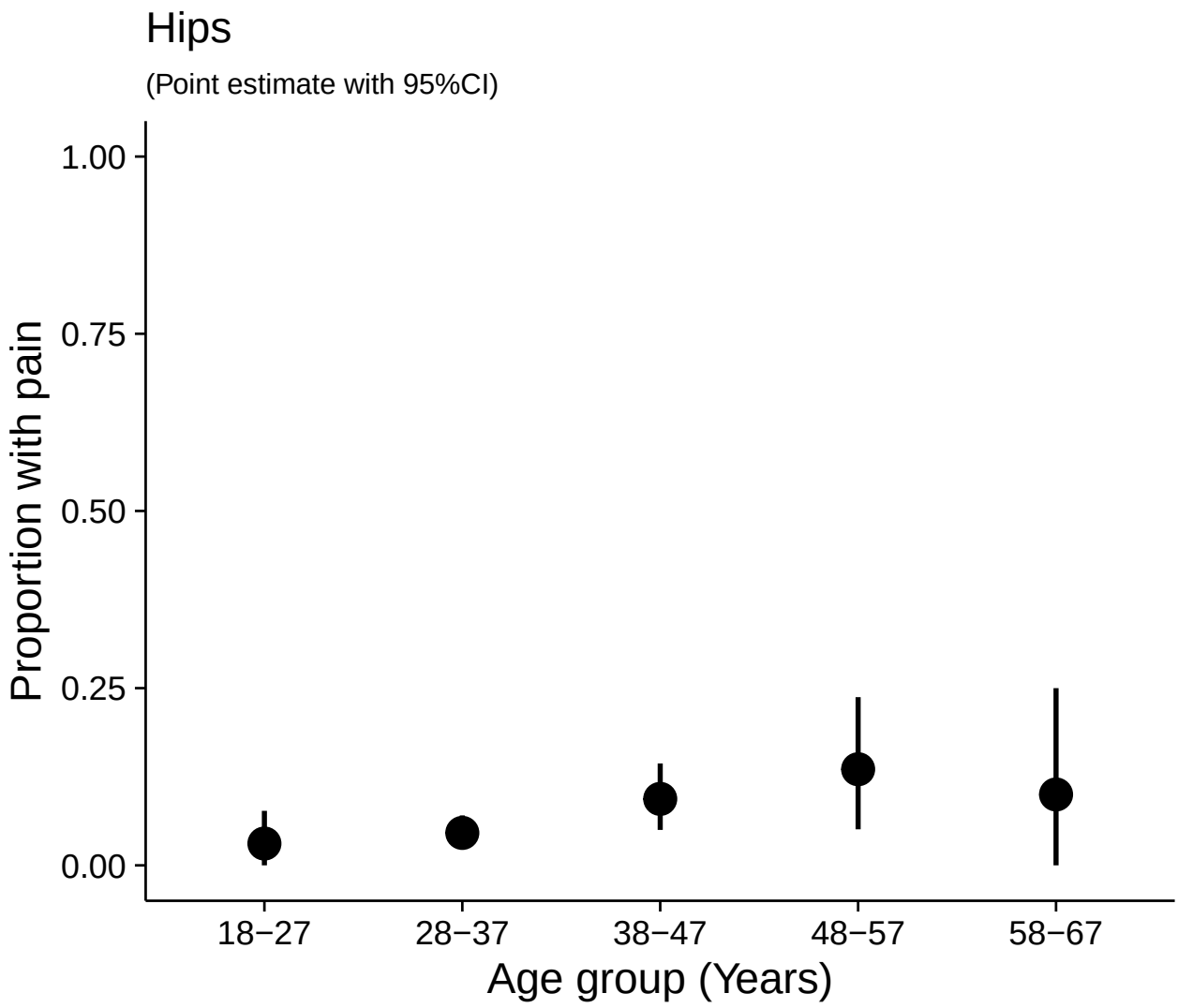

Abdomen
(Point estimate with 95%CI)
Proportion with pain
1.00
0.75
0.50
0.25
0.00
18−27
28−37
38−47
48−57
58−67
Age group (Years)

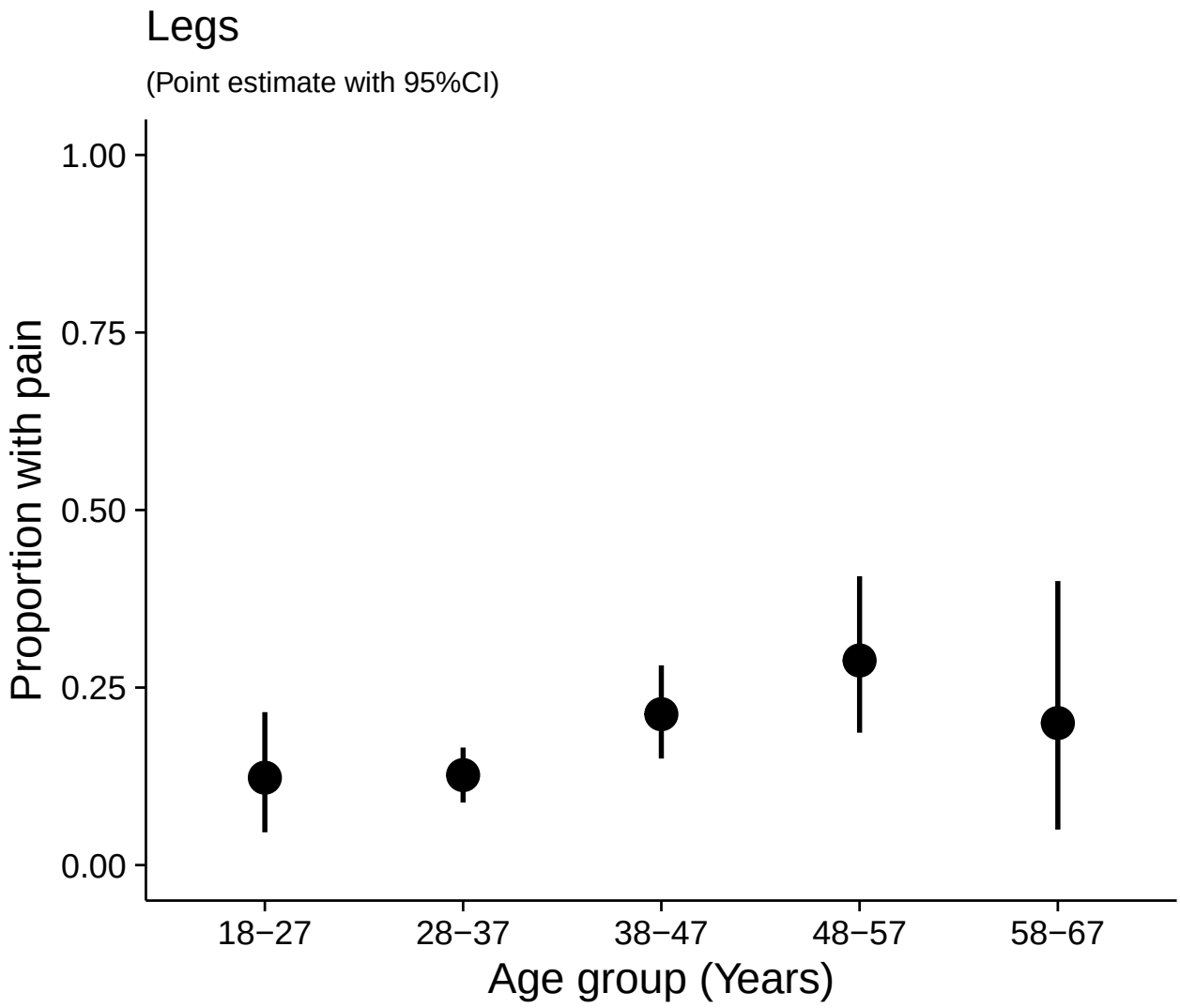

Cervical spine
(Point estimate with 95%CI)
Proportion with pain
1.00
0.75
0.50
0.25
0.00
18−27
28−37
38−47
48−57
58−67
Age group (Years)

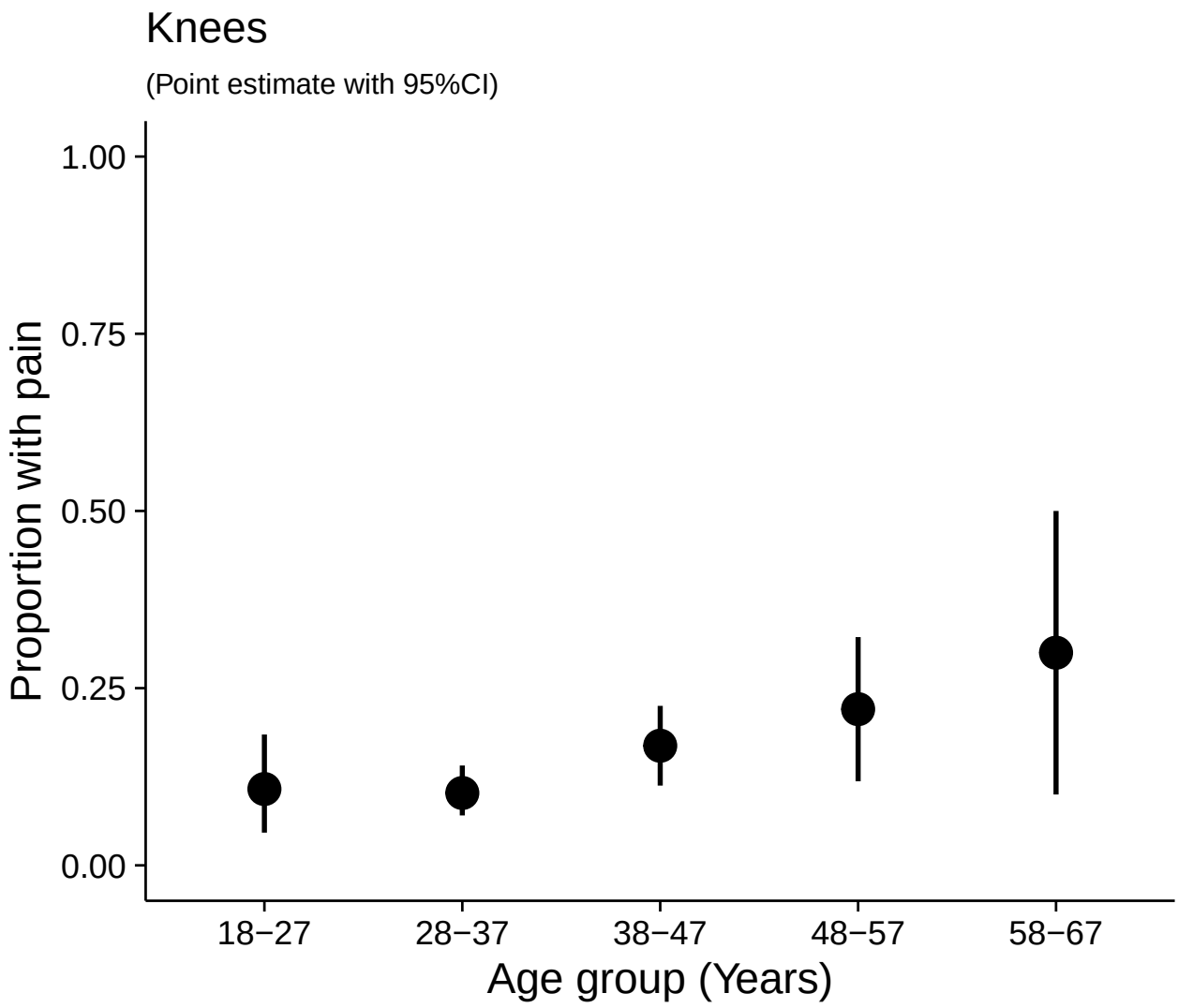

Thoracic spine
(Point estimate with 95%CI)
Proportion with pain
1.00
0.75
0.50
0.25
0.00
18−27
28−37
38−47
48−57
58−67
Age group (Years)

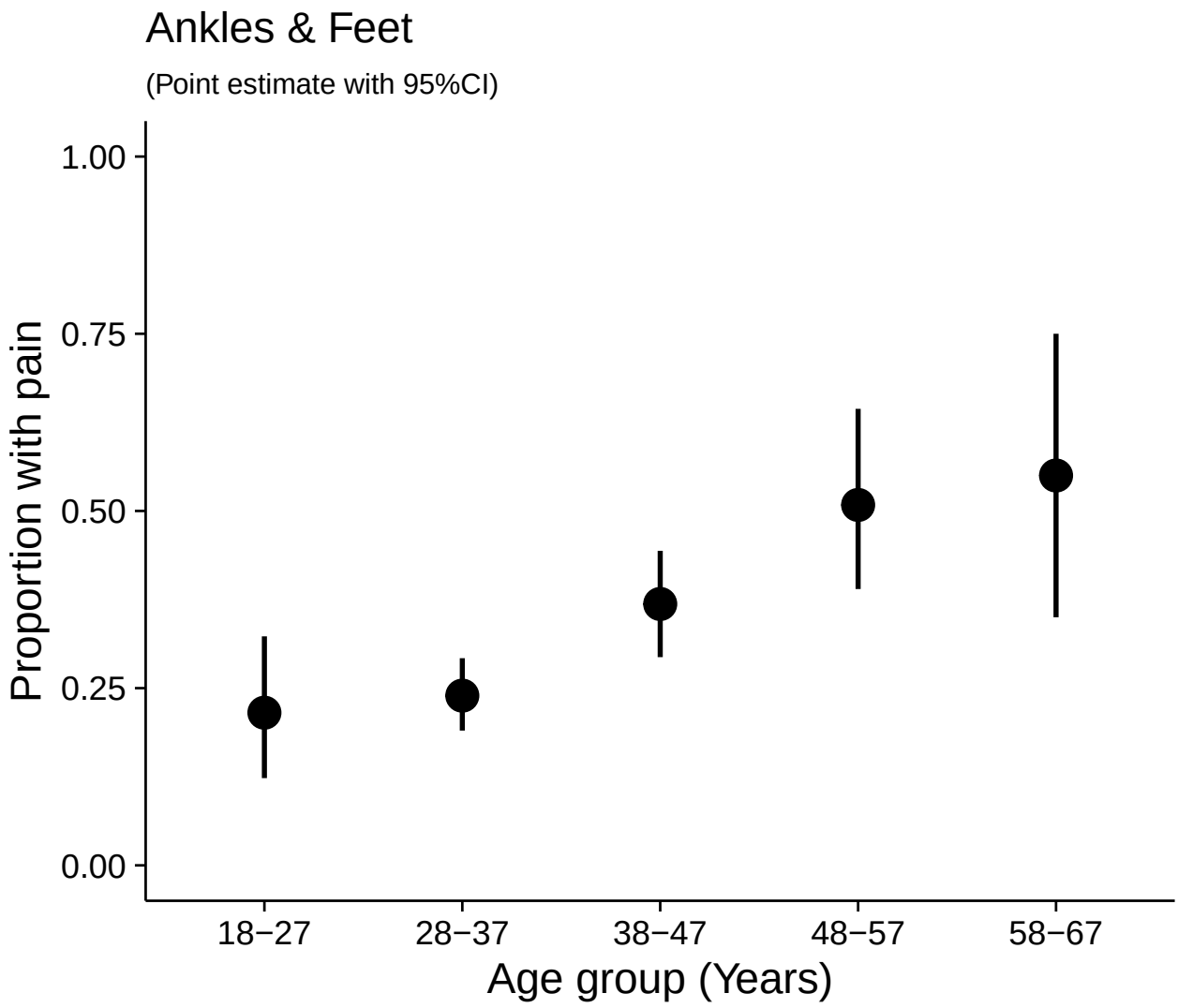

Lumbosacral spine
(Point estimate with 95%CI)
Proportion with pain
1.00
0.75
0.50
0.25
0.00
18−27
28−37
38−47
48−57
58−67
Age group (Years)

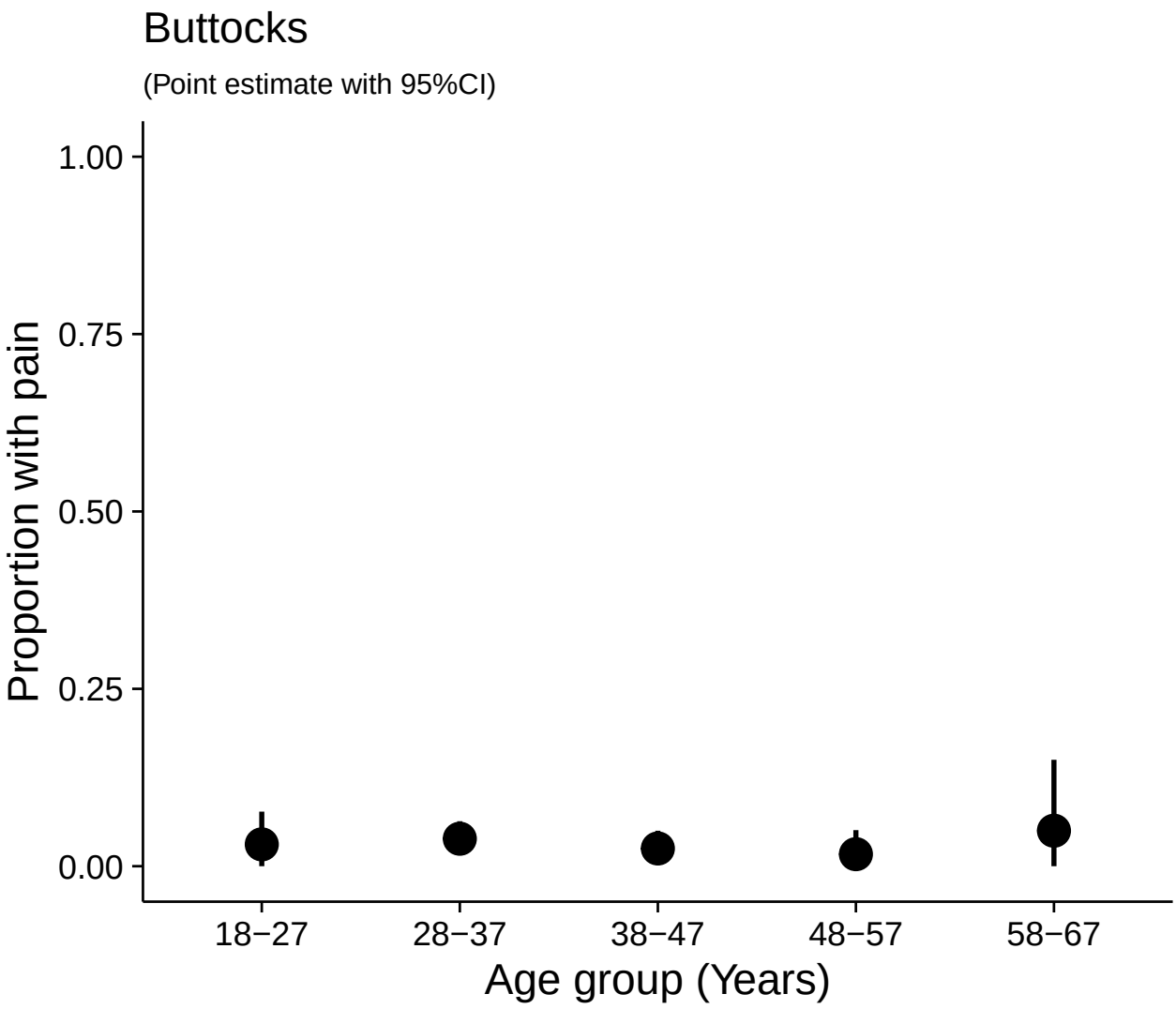

Groin
(Point estimate with 95%CI)
1.00
0.75
0.50
0.25
0.00
Proportion with pain
18−27
28−37
38−47
48−57
58−67
Age group (Years)


Hips
(Point estimate with 95%CI)
1.00
0.75
0.50
0.25
0.00
Proportion with pain
18−27
28−37
38−47
48−57
58−67
Age group (Years)


Legs
(Point estimate with 95%CI)
Proportion with pain
1.00
0.75
0.50
0.25
0.00
18−27
28−37
38−47
48−57
58−67
Age group (Years)


Knees
(Point estimate with 95%CI)
1.00
0.75
0.50
0.25
0.00
Proportion with pain
18−27
28−37
38−47
48−57
58−67
Age group (Years)


Ankles & Feet
(Point estimate with 95%CI)
Proportion with pain
1.00
0.75
0.50
0.25
0.00
18−27
28−37
38−47
48−57
58−67
Age group (Years)



Hypothesis tests

Process data

```
age_tab <- age %>%
    # Convert to long format and nest
    pivot_longer(cols = -Age,
                 names_to = 'site',
                 values_to = 'pain_present') %>%
    group_by(site) %>%
    nest() %>%
    # Remove site with only one outcome (based on skimr summary)
    filter(site != 'Upper_back') %>%
    # Perform logistic regression
    mutate(logistic = map(.x = data,
                          ~ glm(factor(pain_present) ~ Age,
                                data = .x,
```

```
                                family = binomial()))) %>%
    # Extract test statistics
    mutate(OR = map(.x = logistic,
                    ~ exp(coef(.x))[[2]]),
           lower_ci = map(.x = logistic,
                          ~ exp(confint(.x))[2, 1]),
           upper_ci = map(.x = logistic,
                          ~ exp(confint(.x))[2, 2]),
           p_value = map(.x = logistic,
                         ~ coef(summary(.x))[2, 4]))

# Calculate adjusted p-values and then add to nested dataframe
adj_p <- p.adjust(p = age_tab$p_value,
                  method = 'holm')

age_tab$adj_p <- adj_p

# Generate table for each pain site
age_tab <- age_tab %>%
    mutate(tab = pmap(.l = list(site, adj_p, OR, lower_ci, upper_ci),
                      ~ data.frame(site = ..1,
                                   holm_pvalue = ..2,
                                   OR_Yes = ..3,
                                   lower_ci = ..4,
                                   upper_ci = ..5)))
```

Tabulate hypothesis test results

```
# Bind tables and print
bind_rows(age_tab$tab) %>%
    arrange(holm_pvalue) %>%
    kable(caption = 'Age vs body sites: hypothesis test results',
          digits = 3)
```

Table 36: Age vs body sites: hypothesis test results

site	holm_pvalue	OR_Yes	lower_ci	upper_ci
Ankles.Feet	0.000	1.049	1.029	1.070
Knees	0.027	1.039	1.015	1.065
Legs	0.033	1.036	1.013	1.060
Abdomen	0.073	0.969	0.948	0.990
Hips	0.139	1.042	1.009	1.075
Head	0.235	0.976	0.956	0.996
Elbows	0.450	1.045	1.000	1.088
Cervical_spine	0.450	0.950	0.902	0.994
Throat	1.000	1.005	0.953	1.053
Shoulder	1.000	0.989	0.954	1.021
Arms	1.000	1.010	0.966	1.052
Wrists.Hands	1.000	1.026	0.989	1.062
Chest	1.000	0.998	0.976	1.021
Lower_back	1.000	1.008	0.973	1.041

site	holm_pvalue	OR_Yes	lower_ci	upper_ci
Thoracic_spine	1.000	0.984	0.955	1.011
Lumbosacral_spine	1.000	1.010	0.985	1.034
Groin	1.000	0.993	0.961	1.024
Buttocks	1.000	0.991	0.937	1.041