

## Supplementary Table 1 Search strategy

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### Search strategy

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Ovid Embase

1 chronic pancreatitis/

2 autoimmune pancreatitis/

3 alcoholic pancreatitis/

4 exocrine pancreatic insufficiency/

5 ((chronic or advance\* or long-term\* or prolong\* or auto-immune or autoimmune or end-stage\* or alcoholic or persistent or recurr\*) adj3 pancreatit\*).tw,kf.

6 ((chronic or advance\* or long-term\* or prolong\* or auto-immune or autoimmune or end-stage\* or alcoholic or persistent or recurr\*) adj3 (inflam\* or swollen) adj3 pancrea\*).tw,kf.

7 (exocrine adj3 pancrea\* adj3 (deficien\* or deplet\* or insufficien\*)).tw,kf.

8 or/1-7

9 exp bone disease/

10 ((bone or skeleton or skeletal or osteo\*) adj3 (disease\* or disorder\* or absorption\* or anteversion\* or atroph\* or bow\* or contusion\* or cyst\* or decay\* or defect\* or decalcification\* or degeneration\* or demineral\* or damag\* or defect\* or deform\* or dens\* or degrad\* or destruct\* or dysplasia\* or erosion\* or frail\* or infect\* or injur\* or lesion\* or malform\* or necros\* or retroversion\* or scleros\* or soften\* or swell\* or thicken\* or trauma\* or tumor\* or tumour\*)).tw,kf.

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11 (fracture\* or microfracture\* or micro-fracture\* or frontobasal skull injur\* or mandible lesion\* or maxilla lesion\* or Bankart lesion\* or Bankart tear\* or Hill-Sachs lesion\* or Lisfranc injur\* or Lisfranc dislocation\* or tibia trauma).tw,kf.

12 ((broke\* or crush\* or break) adj3 (bone\* or collarbone\* or jaw\* or nose or ankle\* or hip or knee\* or shoulder\* or wrist\* or extremit\* or limb\* or arm\* or leg\* or foot\* or toe\* or finger\* or pelvis or skull or rib\* or sternum)).tw,kf.

13 (osteopath\* or osteoporos\* or osteoporot\* or dysostos\* or aeroosteolys\* or enthesiophyt\* or Farber\* disease or gardner\* syndrome or hyperostos\* or osteopeni\* or osteomalac\* or ostitis or osteitis or panostitis or osteomyelit\* or osteoarthropath\* or osteoarthritis\* or osteoarthros\* or osteo-arthritis\* or osteo-arthros\* or osteodystroph\* or osteophyt\* or osteoscleros\*).tw,kf.

14 vitamin D deficiency/

15 ((Vitamin D\* or Vit D\* or D vitamin or D Vit or calciferol or cholecalciferol or colecalciferol or ergocalciferol) adj3 (deficien\* or deplet\* or insufficien\*)).tw,kf.

16 (D adj3 (hypo-vitaminosis or hypovitaminosis or avitaminosis)).tw,kf.

17 exp Absorptiometry/

18 (DEXA or DXA).ti,ab.

19 Absorptiometr\*.tw,kf.

20 or/9-19

21 8 and 20

Ovid MEDLINE(R) ALL

1 exp Pancreatitis, Chronic/

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2 Pancreatitis, Alcoholic/

3 ((chronic or advance\* or long-term\* or prolong\* or auto-immune or autoimmune or end-stage\* or alcoholic or persistent or recurr\*) adj3 pancreatit\*).tw,kf.

4 ((chronic or advance\* or long-term\* or prolong\* or auto-immune or autoimmune or end-stage\* or alcoholic or persistent or recurr\*) adj3 (inflam\* or swollen) adj3 pancrea\*).tw,kf.

5 Exocrine Pancreatic Insufficiency/

6 (exocrine adj3 pancrea\* adj3 (deficien\* or deplet\* or insufficien\*)).tw,kf.

7 or/1-6

8 exp Bone Diseases/

9 ((bone or skeleton or skeletal or osteo\*) adj3 (disease\* or disorder\* or absorption\* or anteversion\* or atroph\* or bow\* or contusion\* or cyst\* or decay\* or defect\* or decalcification\* or degeneration\* or demineral\* or damag\* or defect\* or deform\* or dens\* or degrad\* or destruct\* or dysplasia\* or erosion\* or frail\* or infect\* or injur\* or lesion\* or malform\* or necros\* or retroversion\* or scleros\* or soften\* or swell\* or thicken\* or trauma\* or tumor\* or tumour\*)).tw,kf.

10 (fracture\* or microfracture\* or micro-fracture\* or frontobasal skull injur\* or mandible lesion\* or maxilla lesion\* or Bankart lesion\* or Bankart tear\* or Hill-Sachs lesion\* or Lisfranc injur\* or Lisfranc dislocation\* or tibia trauma).tw,kf.

11 ((broke\* or crush\* or break) adj3 (bone\* or collarbone\* or jaw\* or nose or ankle\* or hip or knee\* or shoulder\* or wrist\* or extremity\* or limb\* or arm\* or leg\* or foot\* or toe\* or finger\* or pelvis or skull or rib\* or sternum)).tw,kf.

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12 (osteopath\* or osteoporos\* or osteoporot\* or dysostos\* or aeroosteolys\* or enthesiophyt\* or Farber\* disease or gardner\* syndrome or hyperostos\* or osteopeni\* or osteomalac\* or ostitis or osteitis or panostitis or osteomyelit\* or osteoarthropath\* or osteoarthritis\* or osteoarthros\* or osteo-arthritis\* or osteo-arthros\* or osteodystroph\* or osteophyt\* or osteoscleros\*).tw,kf.

13 exp Vitamin D Deficiency/

14 ((Vitamin D\* or Vit D\* or D vitamin or D Vit or calciferol or cholecalciferol or colecalciferol or ergocalciferol) adj3 (deficien\* or deplet\* or insufficien\*)).tw,kf.

15 (D adj3 (hypo-vitaminosis or hypovitaminosis or avitaminosis)).tw,kf.

16 Absorptiometry, Photon/

17 (DEXA or DXA).ti,ab.

18 Absorptiometr\*.tw,kf.

19 or/8-18

20 7 and 19

Scopus

( TITLE-ABS-KEY ( ( bone OR skeleton OR skeletal OR osteo\* ) W/3 ( disease\* OR disorder\* OR absorption\* OR anteversion\* OR atroph\* OR bow\* OR contusion\* OR cyst\* OR decay\* OR defect\* OR decalcification\* OR degeneration\* OR demineral\* OR damag\* OR defect\* OR deform\* OR dens\* OR degrad\* OR destruct\* OR dysplasia\* OR erosion\* OR frail\* OR infect\* OR injur\* OR lesion\* OR malform\* OR necros\* OR retroversion\* OR scleros\* OR soften\* OR swell\* OR thicken\* OR trauma\* OR

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tumor\* OR tumour\* ) ) OR TITLE-ABS-KEY ( fracture\* OR microfracture\* OR micro-fracture\* OR "frontobasal skull injur\*" OR "mandible lesion\*" OR "maxilla lesion\*" OR "Bankart lesion\*" OR "Bankart tear\*" OR "Hill-Sachs lesion\*" OR "Lisfranc injur\*" OR "Lisfranc dislocation\*" OR "tibia trauma" ) OR TITLE-ABS-KEY ( ( broke\* OR crush\* OR break ) W/3 ( bone\* OR collarbone\* OR jaw\* OR nose OR ankle\* OR hip OR knee\* OR shoulder\* OR wrist\* OR extremit\* OR limb\* OR arm\* OR leg\* OR foot\* OR toe\* OR finger\* OR pelvis OR skull OR rib\* OR sternum ) ) OR TITLE-ABS-KEY ( osteopath\* OR osteoporos\* OR osteoporot\* OR dysostos\* OR aeroosteolys\* OR enthesiophyt\* OR "Farber\* disease" OR "gardner\* syndrome" OR hyperostos\* OR osteopeni\* OR osteomalac\* OR ostitis OR osteitis OR panostitis OR osteomyelit\* OR osteoarthropath\* OR osteoarthritis\* OR osteoarthros\* OR osteo-arthritis\* OR osteo-arthros\* OR osteodystroph\* OR osteophyt\* OR osteoscleros\* ) OR TITLE-ABS-KEY ( ( "Vitamin D\*" OR "Vit D\*" OR "D vitamin" OR "D Vit" OR calciferol OR cholecalciferol OR colecalciferol OR ergocalciferol ) W/3 ( deficient\* OR deplet\* OR insufficient\* ) ) OR TITLE-ABS-KEY ( d W/3 ( hypo-vitaminosis OR hypovitaminosis OR avitaminosis ) ) OR TITLE-ABS-KEY ( dxa OR absorptiometr\* ) ) AND ( TITLE-ABS-KEY ( ( chronic OR advance\* OR long-term\* OR prolong\* OR auto-immune OR autoimmune OR end-stage\* OR alcoholic OR persistent OR recurr\* ) W/3 pancreatit\* ) OR TITLE-ABS-KEY ( ( chronic OR advance\* OR long-term\* OR prolong\* OR auto-immune OR autoimmune OR end-stage\* OR alcoholic OR persistent OR recurr\* ) W/3 ( inflam\* OR swollen ) W/3 pancrea\* ) OR TITLE-ABS-KEY ( exocrine W/3 pancrea\* W/3 ( deficient\* OR deplet\* OR insufficient\* ) ) )

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Web of Science Core Collection

#1 TS=((chronic or advance\* or long-term\* or prolong\* or auto-immune or autoimmune or end-stage\* or alcoholic or persistent or recurr\*) near/3 pancreatit\*) or TS=((chronic or advance\* or long-term\* or prolong\* or auto-immune or autoimmune or end-stage\* or alcoholic or persistent or recurr\*) near/3 (inflam\* or swollen) near/3 pancrea\*) or TS=(exocrine near/3 pancrea\* near/3 (deficien\* or deplet\* or insufficien\*))

#2 TS=((bone or skeleton or skeletal or osteo\*) near/3 (disease\* or disorder\* or absorption\* or anteversion\* or atroph\* or bow\* or contusion\* or cyst\* or decay\* or defect\* or decalcification\* or degeneration\* or demineral\* or damag\* or defect\* or deform\* or dens\* or degrad\* or destruct\* or dysplasia\* or erosion\* or frail\* or infect\* or injur\* or lesion\* or malform\* or necros\* or retroversion\* or scleros\* or soften\* or swell\* or thicken\* or trauma\* or tumor\* or tumour\*)) or TS=(fracture\* or microfracture\* or micro-fracture\* or "frontobasal skull injur\*" or "mandible lesion\*" or "maxilla lesion\*" or "Bankart lesion\*" or "Bankart tear\*" or "Hill-Sachs lesion\*" or "Lisfranc injur\*" or "Lisfranc dislocation\*" or "tibia trauma") or TS=((broke\* or crush\* or break) near/3 (bone\* or collarbone\* or jaw\* or nose or ankle\* or hip or knee\* or shoulder\* or wrist\* or extremit\* or limb\* or arm\* or leg\* or foot\* or toe\* or finger\* or pelvis or skull or rib\* or sternum)) or TS=(osteopath\* or osteoporos\* or osteoporot\* or dysostos\* or aeroosteolys\* or enthesiophyt\* or "Farber\* disease" or "gardner\* syndrome" or hyperostos\* or osteopeni\* or osteomalac\* or ostitis or osteitis or panostitis or osteomyelit\* or osteoarthropath\* or osteoarthrit\* or osteoarthros\* or osteo-arthrit\* or osteo-arthros\* or osteodystroph\* or osteophyt\* or osteoscleros\*) or TS(("Vitamin D\*" or "Vit D\*" or "D vitamin" or "D Vit" or calciferol or cholecalciferol or colecalciferol or ergocalciferol) near/3 (deficien\* or deplet\* or insufficien\*)) or TS=(D near/3 (hypo-vitaminosis or hypovitaminosis or avitaminosis)) or TS=(DEXA or DXA or absorptiometr\*)

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#3 #1 and #2

Pubmed

(bone[Title/Abstract) OR skeleton[Title/Abstract) OR skeletal[Title/Abstract) OR osteo\*[Title/Abstract) OR broke\*[Title/Abstract) OR crush\*[Title/Abstract) OR break[Title/Abstract) OR osteoporos\*[Title/Abstract) OR osteoporot\*[Title/Abstract) OR dysostos\*[Title/Abstract) OR aeroosteolys\*[Title/Abstract) OR enthesiophyt\*[Title/Abstract) OR "Farber\* disease"[Title/Abstract) OR "gardner\* syndrome"[Title/Abstract) OR hyperostos\*[Title/Abstract) OR osteopath\*[Title/Abstract) OR osteopeni\*[Title/Abstract) OR osteomalac\*[Title/Abstract) OR ostitis[Title/Abstract) OR osteitis[Title/Abstract) OR panostitis[Title/Abstract) OR osteomyelit\*[Title/Abstract) OR osteoarthropath\*[Title/Abstract) OR osteoarthrit\*[Title/Abstract) OR osteoarthros\*[Title/Abstract) OR osteo-arthrit\*[Title/Abstract) OR osteo-arthros\*[Title/Abstract) OR osteodystroph\*[Title/Abstract) OR osteophyt\*[Title/Abstract) OR osteoscleros\*[Title/Abstract) OR ("Vitamin D\*[Title/Abstract) OR "Vit D\*[Title/Abstract) OR "D vitamin"[Title/Abstract) OR "D Vit"[Title/Abstract) OR calciferol[Title/Abstract) OR cholecalciferol[Title/Abstract) OR colecalciferol[Title/Abstract) OR ergocalciferol[Title/Abstract) OR DEXA[Title/Abstract) OR DXA[Title/Abstract) OR absorptiometr\*[Title/Abstract)) AND (chronic pancreatit\*[Title/Abstract) OR advance\* pancreatit\*[Title/Abstract) OR long-term\* pancreatit\*[Title/Abstract) OR prolong\* pancreatit\*[Title/Abstract) OR auto-immune pancreatit\*[Title/Abstract) OR autoimmune pancreatit\*[Title/Abstract) OR end-stage\* pancreatit\*[Title/Abstract) OR alcoholic pancreatit\*[Title/Abstract) OR persistent pancreatit\*[Title/Abstract) OR recurr\* pancreatit\*[Title/Abstract) OR

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chronic inflammatory pancreas[Title/Abstract) OR chronic swollen pancreas[Title/Abstract) OR exocrine pancrea\* insufficien\*[Title/Abstract) OR exocrine pancrea\* deplet\*[Title/Abstract) OR exocrine pancrea\* deficien\*[Title/Abstract))

Cochrane Library

#1 ((chronic or advance\* or long-term\* or prolong\* or auto-immune or autoimmune or end-stage\* or alcoholic or persistent or recurr\*) near/3 pancreatit\*):ti,ab or ((chronic or advance\* or long-term\* or prolong\* or auto-immune or autoimmune or end-stage\* or alcoholic or persistent or recurr\*) near/3 (inflam\* or swollen) near/3 pancrea\*):ti,ab or (exocrine near/3 pancrea\* near/3 (deficien\* or deplet\* or insufficien\*)):ti,ab

#2 ((bone or skeleton or skeletal or osteo\*) near/3 (disease\* or disorder\* or absorption\* or anteversion\* or atroph\* or bow\* or contusion\* or cyst\* or decay\* or defect\* or decalcification\* or degeneration\* or demineral\* or damag\* or defect\* or deform\* or dens\* or degrad\* or destruct\* or dysplasia\* or erosion\* or frail\* or infect\* or injur\* or lesion\* or malform\* or necros\* or retroversion\* or scleros\* or soften\* or swell\* or thicken\* or trauma\* or tumor\* or tumour\*)):ti,ab or (fracture\* or microfracture\* or micro-fracture\* or "frontobasal skull injur\*" or "mandible lesion\*" or "maxilla lesion\*" or "Bankart lesion\*" or "Bankart tear\*" or "Hill-Sachs lesion\*" or "Lisfranc injur\*" or "Lisfranc dislocation\*" or "tibia trauma"):ti,ab or ((broke\* or crush\* or break) near/3 (bone\* or collarbone\* or jaw\* or nose or ankle\* or hip or knee\* or shoulder\* or wrist\* or extremity\* or limb\* or arm\* or leg\* or foot\* or toe\* or finger\* or pelvis or skull or rib\* or sternum)):ti,ab or (osteopath\* or osteoporos\* or osteoporot\* or dysostos\* or aeroosteolys\* or enthesiophyt\* or "Farber\* disease" or "gardner\* syndrome" or hyperostos\* or osteopeni\* or osteomalac\* or ostitis or osteitis or panostitis or osteomyelit\* or osteoarthropath\* or osteoarthritis\* or osteoarthros\* or osteo-arthritis\* or osteo-arthros\* or osteodystroph\* or osteophyt\* or osteoscleros\*):ti,ab or (("Vitamin D\*" or "Vit D\*" or "D vitamin" or "D Vit" or calciferol or cholecalciferol or colecalciferol or

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ergocalciferol) near/3 (deficien\* or deplet\* or insufficien\*)):ti,ab or (D near/3 (hypo-vitaminosis or hypovitaminosis or avitaminosis)):ti,ab or (DEXA or DXA or absorptiometr\*):ti,ab

#3 #1 and #2

Google scholar

Pancreatitis bone disease

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**Supplementary Table 2 Included studies**

| <b>Authors</b> | <b>Year of publication</b> | <b>Countries</b> | <b>Study design</b> | <b>Study Setting</b> | <b>CP definition</b>  | <b>Controls</b> |
|----------------|----------------------------|------------------|---------------------|----------------------|---|-----------------|
| Moran          | 1997                       | Argentina        | Cross sectional     | Single Center        | <u>Major criteria:</u><br>-were pancreatic calcifications<br>-histological evidence of chronic pancreatitis.<br><u>Minor criteria:</u><br>-typical recurrent abdominal pain in heavy drinkers,<br>-characteristic ultrasound, CT, or ERCP changes,<br>-evidence of exocrine or endocrine insufficiency,<br>-clinical response to enzyme supplementation.<br>1 major or >/3 minor criteria | -               |

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|           |      |                   |                 |                  |  |
|-----------|------|-------------------|-----------------|------------------|--|
| Haaber    | 2000 | Denmark           | Cross sectional | Single<br>Center | <p>1. Reproducible reduction in both duodenal amylase and lipase after a test meal;</p> <p>2. Ultrasonography or CT scan showing pancreatic calcifications/cysts;</p> <p>3. Endoscopic retrograde pancreatography demonstrating dilatation and strictures of pancreatic ducts with or without intraductal stones;</p> <p>4. Radiological evidence of pancreatic calcifications;</p> <p>5. Pathological evidence by biopsy or surgery."</p> |
| Dujcikova | 2008 | Czech<br>Republic | Cross sectional | Single<br>Center | EUS based criteria(standard - classification)  |

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|        |      |       |                      |               |                       |   |
|--------|------|-------|----------------------|---------------|-----------------------|---|
| Tignor | 2010 | USA   | Retrospective cohort | Single Center | CP (ICD-9 code 577.1) | Patients without diagnosis of CP, Crohn's disease, celiac disease, gastrectomy, or cirrhosis.           |
| Sudeep | 2011 | India | Cross sectional      | Single Center | Not defined           | age- and socioeconomic status-matched normal lean men without chronic pancreatitis or diabetes mellitus |

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|             |      |             |                    |               |   |                 |
|-------------|------|-------------|--------------------|---------------|---|-----------------|
| Joshi       | 2011 | India       | Cross sectional    | Single Center | A history of recurrent abdominal pain or diabetes mellitus and radiologic evidence of pancreatic intraductal calculi.               | Community based |
| Duggan      | 2012 | Ireland     | Cross sectional    | Single Center | Based on standard clinical and radiological data  |                 |
| Sikkens     | 2013 | Netherlands | Prospective cohort | Single Center | Clinical symptoms and morphological changes (e.g. calcifications and ductal changes); pancreatic functional insufficiency; or both. | -               |
| Prabhakaran | 2014 | India       | Cross sectional    | Single Center | Imaging and clinical symptoms.  | Undefined       |
| Bang        | 2014 | Denmark     | Prospective cohort | Single Center | International Classification of Diseases, 10th edition codes: K86.0 (alcohol induced CP), K86.1 (other CP)                          | Community based |

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|          |      |         |                 |               |   |   |
|----------|------|---------|-----------------|---------------|---|---|
| Duggan   | 2015 | Ireland | Cross sectional | Single Center | CP was diagnosed on the basis of at least two of the following criteria: patient history (abdominal pain typical of pancreatitis), functional deficits (such as endocrine, exocrine deficiency), and/or findings on imaging studies (computed tomography and/or endoscopic ultrasonography). Severity was classified according to the Cambridge classification. | Control subjects were unpaid volunteers who were recruited from the local community following advertisement and were closely matched for age, sex, and education level. |
| Munigala | 2016 | USA     | Cross sectional | Single Center | CP (ICD-9 code 577.1)   | Undefined   |
| Kumar    | 2017 | India   | Cross sectional | Single Center | Clinical and imaging criteria. Chronic abdominal pain along with either the presence of   | -   |

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|           |      |  |                    |               |   |
|-----------|------|--|--------------------|---------------|---|
|           |      |  |                    |               | pancreatic calcification or atrophy on the ultrasound or the presence of ductal changes on the computed tomography or magnetic resonance imaging. |
| Kuhlmann  | 2018 | Denmark  | Cross sectional    | Single Center | Score $\geq 4$ points based on Lüneburg criteria  |
| Stigliano | 2018 | Estonia, Germany, Italy, Poland, Spain, Sweden, and UK | Cross sectional    | Multicenter   | Probable or definite CP according to the M-ANNHEIM criteria.  |
| Min       | 2018 | USA  | Prospective cohort | Single Center | Endoscopic ultrasound (EUS) criteria and/or Secretin stimulation testing.   |

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|             |      |               |                      |               |   |   |
|-------------|------|---------------|----------------------|---------------|---|---|
| Gupta       | 2019 | USA           | Prospective cohort   | Single Center | Clinical history, cross-sectional imaging, endoscopy, and functional studies.   | - |
| Kanakis     | 2020 | United States | Retrospective cohort | Single Center | Abdominal imaging studies or histology.   | - |
| Tang        | 2021 | China         | Cross sectional      | Single Center | 2002 Asia-Pacific consensus report.   | - |
| Hart        | 2021 | USA           | Cross sectional      | Multicenter   | -Presence of parenchymal or intraductal calcifications,<br>- Cambridge classification of 3 or 4 on computed tomography scan and/or magnetic resonance cholangiopancreatography imaging,<br>-Consistent histology. | - |
| Vujasinovic | 2021 | Sweden        | Retrospective cohort | Single Center | ICD-based code for CP   | - |

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**Supplementary Table 3 Excluded studies**

| <b>Authors</b> | <b>Year of publication</b> | <b>Title</b>   | <b>Journal</b>                                      | <b>Reason for exclusion</b> |
|----------------|----------------------------|--|---|-----------------------------|
| AbouSaleh      | 2020                       | The Risk of Vitamin D Deficiency, Osteoporosis, and Fractures in Acute Pancreatitis  | Pancreas  | Wrong patient population    |
| Abu-El-Haija   | 2018                       | Nutritional status of children and adults before total pancreatectomy with islet autotransplantation: Updates from prospective observational study of TPIAT (POST) | Pancreas  | Wrong outcomes              |
| Abu-El-Haija   | 2018                       | Nutritional Considerations in Pediatric Pancreatitis: A Position Paper from the NASPHAN Pancreas Committee and ESPHAN Cystic                                       | Journal of Pediatric Gastroenterology and Nutrition | Wrong patient population    |

|          |      | Fibrosis/Pancreas Working Group   |                                    |                  |         |
|----------|------|---|------------------------------------|------------------|---------|
| Archana  | 2018 | Relationship between serum vitamin D levels and disease severity in chronic pancreatitis patients                         | Indian Journal of Gastroenterology | of Wrong design  | study   |
| Babinets | 2017 | Clinico-pathogenic aspects of osteodeficiency in osteoarthritis in combination with chronic pancreatitis                  | Wiadomosci lekarskie               | Wrong design     | study   |
| Babinets | 2020 | The Influence of Exocrine Pancreatic Insufficiency in the Formation of Osteopenia in Patients with Primary Osteoarthritis | Wiadomosci lekarskie               | Wrong population | patient |
| Babinets | 2021 | Comparative Analysis of Clinical and Pathogenetic Parameters in Osteoarthritis  | Pharmacologyonline                 | Wrong population | patient |

|         |      | Patients Depending on Etiology of the Comorbid Pathology   |                         |                    |
|---------|------|--|-------------------------|--------------------|
| Bang    | 2011 | Oral cholecalciferol versus ultraviolet radiation B: Effect on vitamin D metabolites in patients with chronic pancreatitis and fat malabsorption - A randomized clinical trial | Pancreatology           | Wrong study design |
| Barassi | 2014 | Pancreatic diseases and vitamin D deficiency   | Biochimica Clinica      | Wrong setting      |
| Bars    | 1978 | [Chronic alcoholic pancreatitis with severe osteomalacia (author's transl)]  | Gastroenterol Clin Biol | Wrong outcomes     |
| Bideeva | 2020 | [The effectiveness of pancreatic enzyme replacement therapy using microencapsulated pancreatin preparations in the   | Ter Arkh                | Wrong outcomes     |

|          |      |  |  |                          |
|----------|------|--|--|--------------------------|
|          |      | correction of nutritional status in patients with chronic pancreatitis: a prospective observational study)   |  |                          |
| Brodlie  | 2012 | Vitamin D in children with cystic fibrosis   | Arch Dis Child                           | Wrong setting            |
| Chavasse | 2004 | Serum vitamin D levels in children with cystic fibrosis  | Pediatr Pulmonol                         | Wrong patient population |
| deRijk   | 2020 | Suboptimal care for chronic pancreatitis patients revealed by moderate to low adherence to the United European Gastroenterology evidence-based guidelines (HaPanEU): A Netherlands nationwide analysis | United European Gastroenterology Journal | Wrong study design       |

|            |      |   |  |   |                      |
|------------|------|---|--|---|----------------------|
| Drozdov    | 2010 | [Role of exocrine pancreatic insufficiency in reducing of the bone mineral density in patients with chronic pancreatitis)               | Äksperimental'naia klinicheskaia gastroenterologii | i | Non-English language |
| Drozdov    | 2010 | [Role of exocrine pancreatic insufficiency in reducing of the bone mineral density in patients with chronic pancreatitis).<br>[Russian) | Eksperimental'naia klinicheskaia gastroenterologii | i | Non-English language |
| Duggan     | 2014 | The prevalence of malnutrition and fat-soluble vitamin deficiencies in chronic pancreatitis   | Nutrition in Clinical Practice                     |   | Wrong outcomes       |
| Dujzakova; | 2008 | Chronic pancreatitis and metabolic osteopathies   | Osteologicky Bulletin                              |   | Non-English language |
| Dujzakova; | 2008 | Chronic idiopathic pancreatitis and metabolic osteopathy  | Ceska a Slovenska Gastroenterologie a Hepatologie  |   | Non-English language |

|            |      |   |                                  |                          |
|------------|------|---|----------------------------------|--------------------------|
| Dujcikova  | 2010 | Chronic pancreatitis and the skeleton. [Czech)  | Vnitřní Lekarství                | Non-English language     |
| Dutta      | 1982 | Deficiency of fat-soluble vitamins in treated patients with pancreatic insufficiency  | Annals of Internal Medicine      | Wrong patient population |
| Gerle      | 1965 | Osseous Changes in Chronic Pancreatitis   | Radiology                        | Wrong study design       |
| Ghiboub    | 2021 | Selective targeting of epigenetic readers and histone deacetylases in autoimmune and inflammatory diseases: Recent advances and future perspectives | Journal of Personalized Medicine | Wrong outcomes           |
| Gubergrits | 2011 | Mineral density of bones in chronic pancreatitis  | Pancreatology                    | Wrong study design       |
| Gupta      | 2022 | Subclinical Pancreatic Exocrine Insufficiency and Bone Health   | Gastroenterology                 | Wrong study design       |

|            |      |  |                         |                    |
|------------|------|--|-------------------------|--------------------|
|            |      | in Patients with Chronic Pancreatitis  |                         |                    |
| Haas       | 2015 | Altered bone metabolism and bone density in patients with chronic pancreatitis and pancreatic exocrine insufficiency         | Journal of the Pancreas | Wrong outcomes     |
| Halabitska | 2021 | Pathogenetic Features of Comorbidity of Primary Osteoarthritis and Diseases with Exocrine Pancreatic Insufficiency           | Georgian medical news   | Wrong outcomes     |
| Hart       | 2020 | High Prevalence of Decreased Bone Mineral Density in Chronic Pancreatitis: A Cross-sectional Analysis From the PROCEED Study | Pancreas                | Wrong study design |



|              |      |   |   |                    |
|--------------|------|---|---|--------------------|
| Hoffbran     | 1965 | CHRONIC PANCREATITIS (ALCOHOLIC) WITH OSTEOMALACIA  | Proceedings of the Royal Society of Medicine-London | Wrong study design |
| Janzen       | 2019 | High-dose Cholecalciferol Supplementation in Adults with Cystic Fibrosis  | Pharmacotherapy                                     | Wrong setting      |
| Joker-Jensen | 2020 | Micronutrient deficits in patients with chronic pancreatitis: Prevalence, risk factors and pitfalls                             | European Journal of Gastroenterology and Hepatology | Wrong outcomes and |
| Khandelwal   | 2017 | Bone health parameters among chronic pancreatitis patients who are at high-risk or have exocrine pancreatic insufficiency (EPI) | Pancreas  | Wrong study design |
| Klapdor      | 2012 | Vitamin D status and per-oral vitamin D supplementation in patients suffering from chronic                                      | Anticancer Research                                 | Wrong outcomes     |

|                |      |  |                                       |                |       |
|----------------|------|--|---------------------------------------|----------------|-------|
|                |      | pancreatitis and pancreatic cancer disease   |                                       |                |       |
| Maire          | 2014 | High prevalence of osteoporosis in patients with chronic pancreatitis.   | Hepato-Gastro et Oncologie Digestive  | Wrong design   | study |
| Manickavasagan | 2019 | Bone health in chronic pancreatitis: A pilot study   | Pancreas                              | Wrong design   | study |
| Manickavasagan | 2019 | Bone health in chronic pancreatitis: A pilot study   | American Journal of Gastroenterology  | Wrong design   | study |
| Mann           | 2003 | Alterations of bone mineral density and bone metabolism in patients with various grades of chronic pancreatitis                        | Metabolism: Clinical and Experimental | Wrong outcomes |       |
| Mann           | 2003 | Vitamin D3 in patients with various grades of chronic pancreatitis, according to morphological and functional criteria of the pancreas | Digestive Diseases and Sciences       | Wrong outcomes |       |

|                          |      |   |   |                          |
|--------------------------|------|---|---|--------------------------|
| Mann                     | 2008 | Fecal elastase 1 and vitamin D3 in patients with osteoporotic bone fractures  | European Journal of Medical Research                | Wrong study design       |
| Marcinowska-Suchowierska | 1988 | [Chymotrypsin activity and vitamin D and calcium metabolism in chronic pancreatitis)  | Wiad Lek  | Wrong outcomes           |
| Mavilakandy              | 2020 | Pilot study examining the impact of a specialist multidisciplinary team clinic for patients with chronic pancreatitis                         | Pancreatology                                       | Wrong outcomes           |
| McEachron                | 2021 | Fat-soluble vitamin deficiency is common in children with chronic pancreatitis undergoing total pancreatectomy with islet autotransplantation | Journal of Pediatric Gastroenterology and Nutrition | Wrong patient population |

|               |      |  |   |                      |
|---------------|------|--|---|----------------------|
| McNabb-Baltar | 2022 | A Pilot Study to Assess Opportunistic Use of CT-Scan for Osteoporosis Screening in Chronic Pancreatitis                  | Frontiers in Physiology                               | Wrong outcomes       |
| Nakamura      | 1996 | Fat-soluble vitamins in patients with chronic pancreatitis (pancreatic insufficiency)                                    | Acta Gastro-Enterologica Belgica                      | Wrong outcomes       |
| Nithin        | 2022 | Bone disease in chronic pancreatitis   | Indian Journal of Gastroenterology                    | Wrong study design   |
| Owor          | 1972 | Quantitative estimation of bone mass in Africans with particular reference to bone changes in chronic pancreatic disease | East African Medical Journal                          | Wrong study design   |
| Parhiala      | 2020 | Osteoporosis in finnish chronic pancreatitis patients  | Pancreas  | Wrong study design   |
| Pasiyeshvili  | 2016 | Chronic Pancreatitis as a Predictor of Osteoporosis Formation  | Eksperimental'naia i klinicheskaia gastroenterologiia | Non-English language |

|           |      |   |  |                          |
|-----------|------|---|--|--------------------------|
| Pezzilli  | 2014 | Vitamin D in patients with chronic benign and malignant pancreatic diseases: A pilot study            | Pancreatology                              | Wrong patient population |
| Pezzilli  | 2015 | Markers of Bone Metabolism in Patients With Chronic Pancreatitis and Pancreatic Ductal Adenocarcinoma | Medicine                                   | Wrong outcomes           |
| Rao       | 2012 | Bone mineral metabolism in patients with alcohol related and idiopathic chronic pancreatitis          | Journal of Gastroenterology and Hepatology | Wrong study design       |
| Skipworth | 2012 | Bone mineral density in patients with chronic pancreatitis  | Pancreatology                              | Wrong study design       |
| Spencer   | 1963 | CHRONIC PANCREATITIS AND BONE DISEASE   | JAMA-J. Am. Med. Assoc.                    | Wrong study design       |
| Sperling  | 1968 | Bone lesions in pancreatitis  | Australas Ann Med                          | Wrong study design       |

|             |      |   |                                      |                    |
|-------------|------|---|--------------------------------------|--------------------|
| Srivoleti   | 2019 | Do Patients with Chronic Pancreatitis Receive Optimal Bone Health Care?                                     | Gastroenterology                     | Wrong study design |
| Srivoleti   | 2021 | Does Provider Type Affect Bone Health Surveillance in Chronic Pancreatitis?                                 | Digestive Diseases and Sciences      | Wrong outcomes     |
| Stadalnik   | 2000 | Incidental finding of pancreatic calcification on bone scan   | Seminars in Nuclear Medicine         | Wrong study design |
| Teichmann   | 2007 | Alterations of vitamin D <sup>3</sup> metabolism in young women with various grades of chronic pancreatitis | European Journal of Medical Research | Wrong outcomes     |
| Tignor      | 2010 | High prevalence of low-trauma fracture in chronic pancreatitis  | Journal fur Mineralstoffwechsel      | Wrong study design |
| Vujasinovic | 2018 | Deficiency of fat-soluble vitamins, minerals and trace elements in patients with                            | Pancreatology                        | Wrong study design |

|         |      |   |          |              |       |
|---------|------|---|----------|--------------|-------|
| Zundler | 1991 | chronic pancreatitis of different etiology<br>[Misdiagnosed osteomalacia in pancreatic insufficiency caused by chronic calcifying pancreatitis) | Med Klin | Wrong design | study |
|---------|------|---|----------|--------------|-------|

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**Supplementary Table 4 Sensitivity analysis of effect size for osteopenia, osteoporosis, and fragility fracture**

| <b>Authors</b>       | <b>Osteopenia effect size w/ study removed</b> | <b>New <math>I^2</math> squared</b> |
|----------------------|--|-------------------------------------|
| Moran                | 0.401 (95% CI: 0.343-0.461)                    | 77.2%                               |
| Haaber               | 0.396 (95% CI: 0.339-0.454)                    | 74.1%                               |
| Dujcikova            | 0.424 (95% CI: 0.362-0.486)                    | 77.2                                |
| Duggan               | 0.414 (95% CI: 0.350-0.479)                    | 79.3%                               |
| Sikkens              | 0.410 (95% CI: 0.348-0.474)                    | 79.2%                               |
| Prabhakaran          | 0.409 (95% CI: 0.346-0.474)                    | 78.8%                               |
| Duggan               | 0.411 (95% CI: 0.348-0.474)                    | 79.2%                               |
| Kumar                | 0.427 (95% CI: 0.372-0.484)                    | 71.0%                               |
| Min                  | 0.409 (95% CI: 0.346-0.473)                    | 79.0%                               |
| Kuhlmann             | 0.405 (95% CI: 0.343-0.468)                    | 78.0%                               |
| Stigliano            | 0.413 (95% CI: 0.346-0.481)                    | 79.0%                               |
| Kanakis              | 0.403 (95% CI: 0.342-0.465)                    | 77.5%                               |
| Tang                 | 0.421 (95% CI: 0.358-0.486)                    | 78.2%                               |
| Vujasinovic          | 0.423 (95% CI: 0.361-0.487)                    | 76.7%                               |
| Hart                 | 0.416 (95% CI: 0.348-0.487)                    | 79.4%                               |
| All studies included | 0.412 (95% CI: 0.352-0.473)                    | 77.764%                             |



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|             |                             |      |
|-------------|-----------------------------|------|
| Haaber      | 0.208 (95% CI: 0.145-0.278) | 94.3 |
| Dujsikova   | 0.221 (95% CI: 0.155-0.294) | 94.4 |
| Sudeep      | 0.205 (95% CI: 0.143-0.274) | 94.2 |
| Joshi       | 0.203 (95% CI: 0.142-0.271) | 93.9 |
| Duggan      | 0.202 (95% CI: 0.141-0.270) | 94.0 |
| Sikkens     | 0.22 (95% CI: 0.15 -0.29)   | 94.4 |
| Prabhakaran | 0.203 (95% CI: 0.143-0.272) | 93.9 |
| Bang        | 0.219 (95% CI: 0.164-0.278) | 84.4 |
| Duggan      | 0.204 (95% CI: 0.143-0.273) | 94.2 |
| Kumar       | 0.221 (95% CI: 0.155-0.295) | 94.4 |
| Min         | 0.208 (95% CI: 0.146-0.278) | 94.3 |
| Kuhlmann    | 0.205 (95% CI: 0.144-0.275) | 94.1 |
| Stigliano   | 0.208 (95% CI: 0.145-0.280) | 93.8 |
| Gupta       | 0.193 (95% CI: 0.136-0.256) | 93.4 |
| Kanakis     | 0.204 (95% CI: 0.142-0.272) | 94.1 |
| Tang        | 0.221 (95% CI: 0.155-0.295) | 94.4 |
| Vujasinovic | 0.206 (95% CI: 0.144-0.275) | 93.9 |
| Hart        | 0.212 (95% CI: 0.145-0.287) | 94.0 |

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|                      |                             |       |
|----------------------|-----------------------------|-------|
| All studies included | 0.209 (95% CI: 0.149-0.276) | 93.8% |
| Dujcikova            | 0.064 (95% CI: 0.042-0.090) | 96.1  |
| Tignor               | 0.061 (95% CI: 0.036-0.091) | 95.3  |
| Sudeep               | 0.067 (95% CI: 0.045-0.094) | 95.9  |
| Bang                 | 0.055 (95% CI: 0.034-0.080) | 91.0  |
| Munigala             | 0.061 (95% CI: 0.037-0.091) | 95.1  |
| Stigliano            | 0.059 (95% CI: 0.037-0.085) | 96.2  |
| Kanakis              | 0.055 (95% CI: 0.034-0.081) | 96.2  |
| Vujasinovic          | 0.046 (95% CI: 0.028-0.067) | 95.2  |
| Hart                 | 0.066 (95% CI: 0.043-0.092) | 95.9  |
| All studies included | 0.059 (95% CI: 0.039-0.084) | 95.7  |

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|                                   |        |    |    |        |        |   |        |        |   |   |   |   |   |   |   |   |   |   |   |   |
|-----------------------------------|--------|----|----|--------|--------|---|--------|--------|---|---|---|---|---|---|---|---|---|---|---|---|
| Ascertainment of exposure         | 2      | 2  | 2  | 2      | 2      | 2 | 2      | 1      | 2 | 2 | 1 | 2 | 2 | 2 | 2 |   |   |   |   |   |
| Selection Total                   | 3      | 3  | 3  | 3      | 3      | 3 | 3      | 1      | 3 | 3 | 2 | 4 | 2 | 3 | 3 |   |   |   |   |   |
| Comparability                     | N<br>A | NA | NA | N<br>A | N<br>A | 2 | N<br>A | N<br>A | 1 | 2 | 2 | 2 | 2 | 2 | 2 |   |   |   |   |   |
| Assessment of the outcome         | 2      | 2  | 2  | 2      | 2      | 2 | 2      | 2      | 2 | 2 | 2 | 2 | 2 | 2 | 2 |   |   |   |   |   |
| Statistical test                  | 1      | 0  | 1  | 1      | 1      | 1 | 1      | 1      | 1 | 1 | 1 | 1 | 1 | 1 | 1 |   |   |   |   |   |
| Outcome Total                     | 3      | 2  | 3  | 3      | 3      | 3 | 3      | 3      | 3 | 3 | 3 | 3 | 3 | 3 | 3 |   |   |   |   |   |
| Representativeness of the exposed |        |    |    |        |        |   |        |        |   |   |   |   |   |   | 0 | 1 | 0 | 1 | 1 | 1 |

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cohort

Selection  
of the  
non  
exposed  
cohort

N N NA NA NA 1  
A A

Ascertain  
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exposure  
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ration  
that  
outcome  
of  
interest  
was not

1 1 1 1 1 1  
0 0 NA 0 0 NA

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|             |   |   |   |    |   |   |
|-------------|---|---|---|----|---|---|
| present     |   |   |   |    |   |   |
| at start of |   |   |   |    |   |   |
| study       |   |   |   |    |   |   |
| Selection   | 1 | 2 | 1 | 2  | 2 | 3 |
| Domain      |   |   |   |    |   |   |
| Total       |   |   |   |    |   |   |
| Compar      | N | N | 2 | NA | 1 | 2 |
| ability of  | A | A |   |    |   |   |
| cohorts     |   |   |   |    |   |   |
| on the      |   |   |   |    |   |   |
| basis of    |   |   |   |    |   |   |
| design or   |   |   |   |    |   |   |
| analysis    |   |   |   |    |   |   |
| Ascertain   | 1 | 1 | 1 | 1  | 1 | 1 |
| ment of     |   |   |   |    |   |   |
| outcome     |   |   |   |    |   |   |

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|         |   |   |   |    |   |   |
|---------|---|---|---|----|---|---|
| Was     | 1 | 1 | 0 | 1  | 0 | 1 |
| follow  |   |   |   |    |   |   |
| up long |   |   |   |    |   |   |
| enough  |   |   |   |    |   |   |
| for     |   |   |   |    |   |   |
| outcome |   |   |   |    |   |   |
| s to    |   |   |   |    |   |   |
| occur   |   |   |   |    |   |   |
| Adequac | 1 | 0 | 0 | NA | 1 | 1 |
| y of    |   |   |   |    |   |   |
| follow  |   |   |   |    |   |   |
| up of   |   |   |   |    |   |   |
| cohorts |   |   |   |    |   |   |
| Outcome | 2 | 1 | 1 | 1  | 2 | 2 |
| Domain  |   |   |   |    |   |   |
| Total   |   |   |   |    |   |   |

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